SCIENTIFIC AMERICAN

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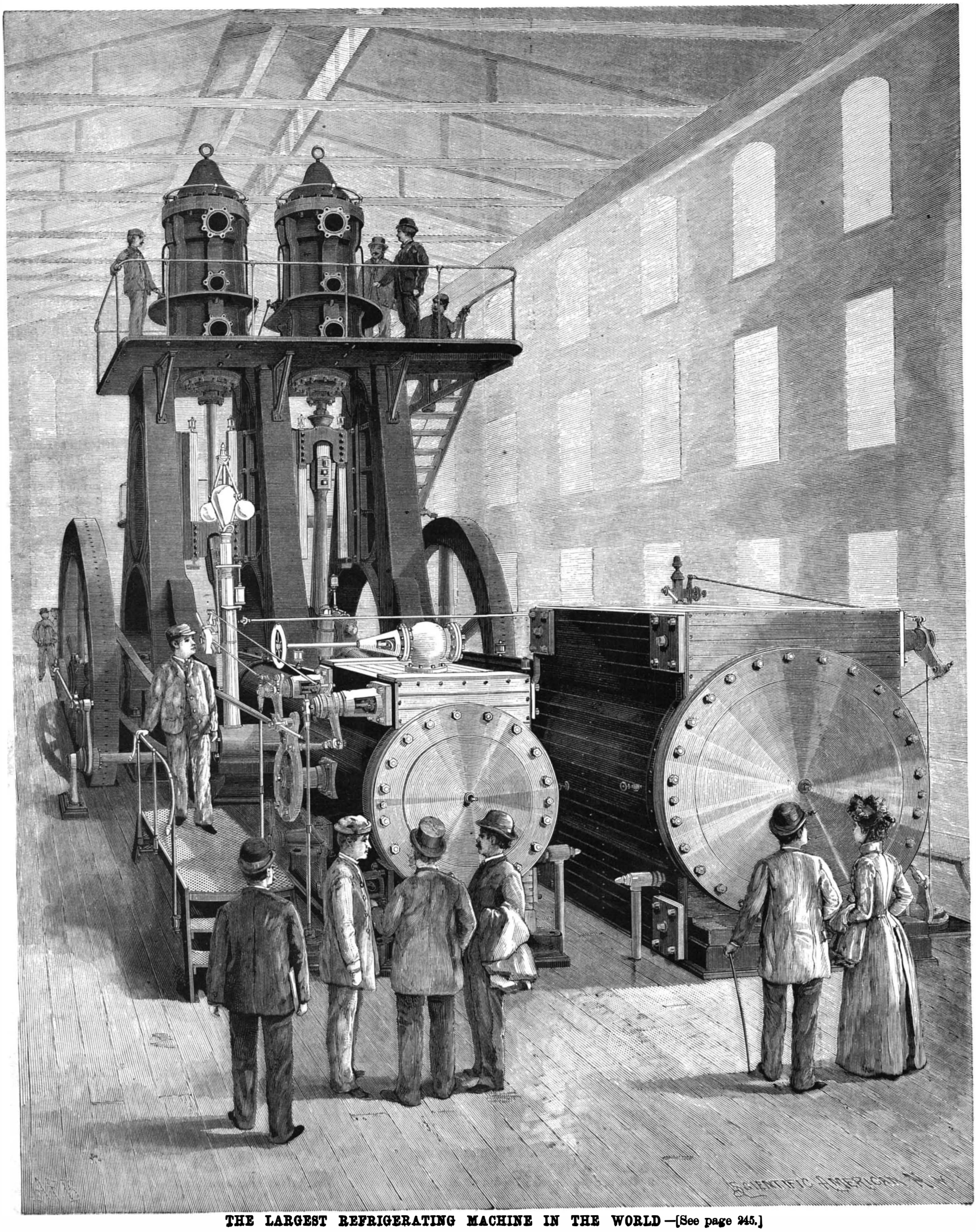

THE LARGEST REFRIGERATING MACHINE IN THE WORLD.—[See page 245.]

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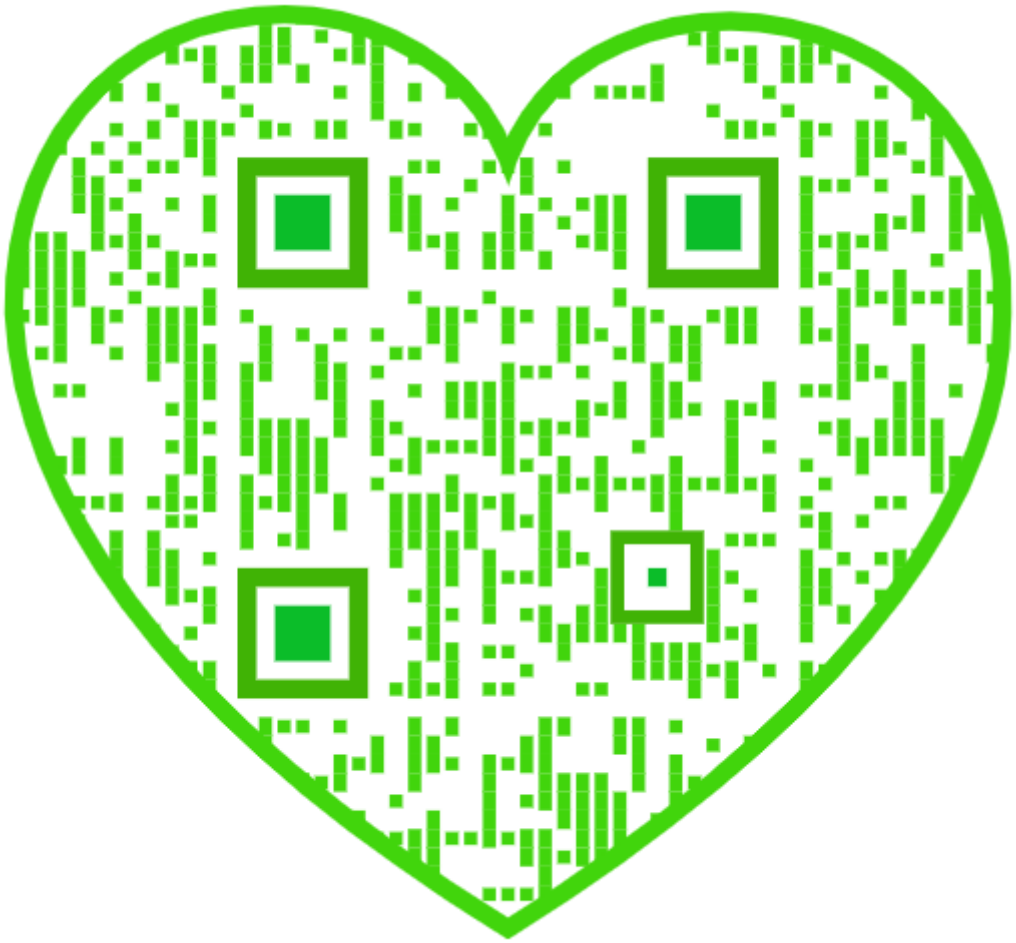

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A REMARKABLE CHEMICAL COMPOUND—NICKEL CARBON OXIDE.

A most curious and interesting chemical compound, one which may yet be the basis of important industrial processes, is the newly discovered nickel carbon oxide. Ludwig Mond, F.R.S., while working upon nickel and investigating its remarkable power of dissociating carbon monoxide into carbon and carbonic dioxide, accidentally produced the new compound. If nickel is heated in an atmosphere of carbon monoxide, it separates carbon, and if the hot mass of carbon and nickel is exposed to the air, it spontaneously takes fire. To avoid this result, Mond, in his laboratory work, very naturally cooled the carbon and nickel in a stream of carbonic oxide gas, and in order to avoid poisoning the air of the laboratory passed the gas into a Bunsen burner and lighted it. As the mass cooled, the flame became luminous, and grew brighter and brighter as the temperature fell.

This very extraordinary phenomenon was investigated. The gas before reaching the burner was passed through a glass tube which was heated, as in the well known Marsh test for arsenic. A bright mirror was deposited on the tube and the flame lost its luminosity. Evidently the substance of the mirror was the agent in making the flame luminous. On analysis, it proved to be nickel of a high degree of purity.

In short, a discovery was fairly stumbled upon, that the hard, difficultly expansible, iron-like metal, nickel, could be carried off at ordinary temperatures by carbon monoxide gas, the metal and gas combining to form a volatile compound.

By special care the substance was produced in quantity, and was condensed by cold into a liquid of high refracting power, expanding very much with heat, and very volatile. Its specific gravity is 1·3185. At 13° F. below 0 (—25° C.) it solidifies into needle-shaped crystals. It is quite explosive; sudden changes of temperature or jarring, by scratching with a file the tube containing the pure vapor, determines its violent explosion. Mixed with air, it explodes when a flame is applied to the mixture. Its formula is, $Ni(CO)_4$; one atom of nickel to four molecules of carbon monoxide, giving 34·28 per cent of nickel.

The compound is decomposed by heat without explosion, when the heat is properly applied. This was what took place in the first experiment with the Bunsen burner. At 392° F. the metal separates. The entire percentage of carbonic oxide is liberated, and perfectly pure coherent metallic nickel is produced.

In the above there are suggestions of the possibilities of this reaction. It now seems practicable to plate with nickel by this process. A heated body, whether a conductor or not, is rapidly coated with a fine coating of nickel, if acted on by the new compound. This suggests the plating of glass, china, and many other non-conductors, something which necessitated formerly an initial coating with graphite, platinum, or some equivalent, to act as a conductor for the electric current. Again, this nickel deposit may be made very thin, and may then be employed as a base for gold or silver plating on glass or china.

When the possibilities of the process in the extraction of nickel from its ores is considered, the subject assumes new importance. It is suggested that nickel may be separated by carbon monoxide gas, the metal may be separated by heat, and the same gas may be used over and over again until the ore is exhausted as if by a gaseous leaching process. The metallurgy of nickel has hitherto been anything but satisfactory. If it leads to the economical production of pure nickel, Mond's discovery will have accomplished a great deal.

The chemist sees in it a basis for the analytical separation of nickel and cobalt. The method, if practicable, would be a most elegant and neat one. Many substances have been examined, but iron is the only one that forms an analogous compound, and this compound is obtained far less readily than is the nickel one. Its use in analysis seems quite feasible.

In experimenting with it the highly poisonous nature of carbon monoxide gas should be kept in view. None should be allowed to escape into the room, and the nickel compound itself is highly poisonous if respired. This suggests one other property which was investigated—its physiological action on the animal system. If injected into the veins, it lowers the temperature to a remarkable extent. The experiment was tried upon a rabbit; an extremely small dose produced a fall of temperature of over 20° F.

For fuller accounts of this substance, Prof. Mond's paper given in a recent SCIENTIFIC AMERICAN SUPPLEMENT (No. 823) should be consulted. Should the new compound realize but a small proportion of what it suggests, it will prove the most valuable of recent discoveries.

MRS. MARIA LOUISA PIKE.

Mrs. Maria Louisa Pike, wife of Col. Nicolas Pike, died at her residence in Brooklyn, N. Y., on March 23. She was a lady of many scientific accomplishments. Born in England, and when seventeen years of age accompanied her father, Hon. Benjamin Hadley, to his station as British Commissioner to South Africa, acted as his secretary for a number of years, and employed her leisure hours in acquiring knowledge of South African flora and kindred subjects.

In 1870 she resided in the island of Mauritius, which is in the Indian Ocean, at least a thousand miles from the mainland. Col. Nicolas Pike, her future husband, was the United States Consul there, and was making a thorough study of the scientific features of the island. He gave special attention to the fish of the Indian Ocean, many new and valuable specimens of which he collected and sent to Prof. Agassiz for his museum at Cambridge, Mass. Mrs. Pike, who had made great progress in the acquirement of scientific knowledge and also in the art of drawing from nature, assisted Col. Pike in classifying the more than eight hundred different species which he secured, and she also made drawings of them, which she colored to represent the wonderful hues peculiar to the fish of that locality.

Mrs. Pike came to this country about seventeen years ago and here married Col. Pike. Since then she has written voluminously, contributing many interesting articles on various subjects to the SCIENTIFIC AMERICAN, *American Agriculturist*, *American Garden*, besides English and French journals. Her effectiveness as a writer was greatly enhanced by her skill as an artist. Her illustrations were skillfully executed and aided greatly in elucidating the subject treated. Among many other works from her pencil, Mrs. Pike illustrated in colors various portions of a very complete collection of spiders which her husband made, and she also executed drawings with pen and ink of the snakes of the United States. This work required a vast amount of labor and patience.

Mrs. Pike was a member of the Brooklyn Institute of Arts and Sciences, and took special interest in the department of botany, where her wide experience and store of knowledge were of great service to her associates. She was, however, an enthusiastic and painstaking student in many departments of science.

The Pogonip Fog.

The city of Carson, Nev., experienced the other evening the thickest and coldest pogonip fog "in the memory of the oldest inhabitant," says a writer in a recent issue of the *Evening Post*. The pogonip fog is peculiar to elevated altitudes in the Nevada Sierras. It ascends from the valleys, and its chill embrace is so much feared by the Indians, who are predisposed to affections of the lungs, that they change their camp if apprised by the atmospheric conditions that the dreaded fog is approaching. Mr. Ogden, a chemist of the Nevada Mining Bureau, furnishes this pleasing description of the pogonip:

"In the White Pine Mountains, the Toyabi, the Hyko, and the Pahranagat ranges it is quite common to see the trees, houses, and everything out in the open gradually become white without any apparent cause. There is no perceptible fog, but the hot air from the valleys gradually ascends up the mountain side, and, becoming crystallized, the minute crystals attach themselves to anything in sight. This phenomenon affects human beings in just the same manner, and when the fog passes by, the frozen particles will adhere to the hair and clothing, producing a very grotesque effect. Hot Creek Valley is situated right in the center of the mining district, and is so called because of the warm springs that are always to be found there. These springs cause a pogonip in that district every night, and for this reason: The wind in the valley always blows from one direction in the daytime, and after sunset it invariably blows from the opposite point. The effect of the cooler air passing over the hot valley is to force the heated air to rise. When it reaches a temperature of about 25°, the result is a pogonip."

The Best Mosquito Remedy.

Mr. C. H. Russel, of Bridgeport, Conn., has recently communicated to us the following interesting fact: A very high tide recently broke away the dike and flooded the salt meadows of Stratford, Conn. The receding tide left two lakes nearly side by side of the same size. In one lake the tide left a dozen or more small fishes, while the other one was fishless. A recent examination showed that while the fishless lake contained tens of thousands of mosquito larvæ, that containing the fishes had in it no larvæ.

An English gentleman living on the Riviera, according to a correspondent of *Nature*, having been troubled by mosquitoes, discovered that they bred in the large tanks kept for the purpose of storing fresh water, which is rather a rare commodity at this Mediterranean resort. He put a pair of carp in each tank and succeeded in this way in extirpating the insect pest.

The utilization of fish in this way is an old suggestion, and a very practical one under some circumstances. Many people suffer from the mosquito plague when the insect breeds in a circumscribed and easily accessible place, and where it could be destroyed by some such method as that used by the level-headed Englishman.—*Insect Life.*

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New Mode of Producing Colored Photographs.

This is a process by James W. McDonough, of Chicago, Ill., who describes it as follows:

I take a support of plain glass, celluloid, paper, or other suitable substance, upon the surface of which is a sensitive photographic coating, preferably forming what is known as an "orthochromatic dry plate." This may be rendered tacky by immersion in water or diluted glycerine. If preferred, however, the plate may be used before it becomes quite dry in the course of its manufacture. I dust the plate, either while it is somewhat moist in the course of its manufacture or after it has become tacky, as above explained, with a mixture of colors composed of fine or powdered particles containing the colors desired. I thus obtain a colored surface composed of particles lying side by side which have the properties of stippled colors instead of the properties of a true mixture of pigments. In order to get these colored particles, I use colored powdered glass, transparent pigments, gelatine, resin, shellac, or similar substances stained by aniline dyes, etc. In the preparation of the colors by means of shellac I take a sufficient quantity of clean white shellac dissolved in alcohol, to which I add aniline colors—say for one lot red and yellow colors—in such proportions that the result will be a red, which when viewed by transmitted light in layers will cut off or absorb as much green, blue, violet, and yellow as possible, or which, in other words, will transmit as far as possible a pure red. Another lot is colored with as pure a green as may be formed by mixtures adding yellow to absorb blue. Another lot is colored blue. As the mixture of colors formed in this way by red and green does not form a bright yellow, I may use in addition another lot colored as near the yellow of the spectrum as possible. These lots, after being thus colored, are allowed to dry, forming colored masses, which are then reduced to powder by grinding, sifting, etc.

If now proper proportions of red and green are mixed, a nearly black or gray mass will be formed, and if proper proportions of red, green, yellow, and blue are mixed, a mass will be formed that is nearly black or gray; but if this same mixture is dusted or finely spread upon the prepared sensitive surface, it will reflect or transmit a mixture of all these colors, which will be white in proportion to the purity of color, cleanliness of mixture and quantity of light transmitted or reflected. The glycerine may be washed out, so that only the colored particles in the mass in which they are arranged remain. When viewed under the microscope, the white surface is seen to be composed of a multitude of different colored particles lying side by side and separated by small distances. This surface may be flowed with a thin coat of gelatine, which will penetrate the spaces between the colored particles, or the ground and colored particles may be coated with gelatine before applying them to the tacky surface by mixing them with a small quantity of dissolved gelatine and regrinding them, according as a mat or smooth surface is required.

The process of producing the effect called "color," above described, is by absorption of light; but inasmuch as color effects may also be produced by refraction, dispersion, or diffraction of light, I do not mean to limit myself to absorption only as the means of producing them.

The photographic plate thus obtained, consisting of colored particles applied to its sensitive surface, may be exposed to the action of the light from the object to be photographed through a camera in such manner that this light will pass through the colored particles and affect the sensitive film, thus producing a latent image of the object. The plate may then be developed by the use of the so-called "alkaline pyro developer," so that the colored particles will adhere to the surface, which is penetrated by the same colored light as the particles themselves, because gelatine is rendered insoluble in proximity to the silver particles in the sensitive compound where acted upon by light. Thus particles which do not allow the passage of colored rays on account of absorption may be washed off, because as to such particles the gelatine remains soluble. Thus blue rays will cause blue particles to remain as an image, white light all the colored particles in that space acted upon by white light, and all will be removed where black occurs, which does not act upon the photographic film. After the development, the picture may be treated with thiosulphate of soda to remove the sensitive compound not acted on by the light and developer. By thus developing the plate a picture is produced composed of the particles of silver and the colored particles remaining on the plate after the development. This picture may be used as a negative or backed with a black or other colored surface, as in an ambrotype. The colored image is formed by the reflection of light from the particles or through the particles from the silver image or by the transmission of light through them when not cut off by the image. The use of the orthochromatic sensitive plates and colored screens before the camera for the purpose of sifting light and regulating the action of different colors upon the film is too well known to require explanation. I will merely add that the particles are dusted, spread, or placed upon the plate in such proportions as to produce a white or transparent surface.

[FOR THE SCIENTIFIC AMERICAN.]

Inventors' Persistence.

Starting with Professor Morse, the great discoverer of transmitting messages by lightning and inventor of the first machine for that purpose, his struggles and remarkable success is certainly one of the wonders of the nineteenth century. About 1832 the professor is said to have conceived the idea while on a voyage across the Atlantic, and soon after his return set at work experimenting in a small way in connection with his devoted wife.

For nearly ten years they worked and struggled, most of the time poor, until at last they hoped for success in long distances. The professor, through a few New York Congressional Representatives and one of the New York Senators, who promised to aid him in getting an appropriation of, I think, $30,000, to construct an experimental line from Washington, D. C., to Baltimore, Md., a distance of about 30 to 35 miles. The professor had obtained permission to string several miles of wires through the United States capital and set up his machines, with himself at one end and Mrs. Morse at the other, at remote corners of the capital. The President of the United States was the first to investigate, and expressed himself very favorable to the appropriation. Committees were appointed from the House to investigate, and finally succeeded in getting the bill passed by that body by a small majority.

But this must be confirmed by the Senate. Several times the bill was called up and tabled. All of this time the professor's expenses were increasing, even his board bill at his hotel. Finally on Saturday night, between 11 and 12 o'clock, the bill, with others, was called up and defeated by one single vote. The professor left the capital a very sad man. The other New York Senator had been trying to get a bill through for a New York harbor appropriation and it failed by one vote also, each Senator being hostile to the other's bill. After the professor left, his friend walked over to the other New York Senator and said: "This is too bad. I now propose to move to call both these bills up if you will second my motion." This was agreed, and the Morse bill was hitched on as a tail to the harbor bill kite and both passed, and the President was there to sign them. The professor said that he went home, but could not sleep. In the morning (Sunday) when he came down the landlady met him. "Professor, allow me to congratulate you." And next came the landlord with congratulations. And next his Senator friend, who took him by the hand. Said the professor, "What does all this mean? I wish you could congratulate me, but my bill was defeated."

"No, sir," said his Senator friend, "your bill passed and was signed after you left the House, and there is $30,000 in the Treasury to your order."

I was one of the fortunates who stood in Central Park, New York City, when the bronze statue to Professor Morse was unveiled, and there stood the grand old man to whose achievement this memento had been erected by the telegraph operators, and it was then that the professor telegraphed under the Atlantic Ocean in that cable that is strung along among huge monsters that roam in its endless abysses and chasms, and onward clear around our globe. Never was such an achievement realized by one mortal being. Almost every one knows the first message of four words, "What hath God wrought!"

Elias Howe with the sewing machine met a similar fate. His first machines were crude made machines indeed, and his first claims were on the machinery, which was subject to vast variations and numerous evasions. But a happy thought came to Mr. Howe, so he surrendered his first patent and took out a new one, in which he claimed a needle with the eye at or near the point. For about seven years young Howe struggled to get his machines into use; but the early prejudices against using any machine that would throw poor sewing girls out of work defeated him, so he tried England, and there met a similar fate. Finally he raised enough money to get his wife home, and he worked his passage as cook in a sailing vessel, with bare money to get home to Massachusetts.

In walking up Broadway he saw large warerooms of finely finished machines, all using his needle. He went home and induced his father to mortgage his farm for money and commenced suit against every firm using his needle, and carried it to the Supreme Court and got judgment against them. The master brought in $5 damages on every machine made, and it is said that his first money on this royalty paid him over $160,000, and he died an eccentric millionaire.

The next struggler was Hussey, with his guard tooth mowing machine. Mr. McCormick had invented and patented a reaper and used a heavy sliding cutter bar that often caused it to clog by the grass or grain to bend over and wedge it. Hussey saw this and made the guard tooth having a slot through near the center to prevent the grain bending over and clogging the cutter. This improvement he patented, but Mr. McCormick claimed the sliding cutter very broadly, and commenced suit against Hussey for infringement, and beat poor Hussey in the lower courts.

P. H. Watson, then a prominent patent attorney, and afterward Assistant Secretary of War under Stanton, and afterward president of the Erie Railroad Company, and who died the same day that General Grant died, told me that poor Hussey came to him and said:

"Watson, I can't carry on this suit. I am in debt now over $3,000, and can't get money to make the appeal."

Mr. Watson said: "Mr. Hussey, if you will assign me a one-half interest in your invention, I will give you $5,000 ready cash and carry on the suit for you without further charge."

Hussey did not lose a moment, but made the assignment at once, and Mr. Watson told me that when he handed him a check for $5,000 Hussey was the happiest man to all appearance that he ever saw. They carried on and won their case before the United States Supreme Court, and Mr. Watson told me that he (Mr. Watson) made over $300,000 clear out of that one transaction.

J. E. EMERSON.

Electrical Tanning.

The following report has recently been issued by Mr. Georges Hannenstein, at Verviers, Belgium, upon some experiments recently conducted there in "electrical tannage."

The apparatus consisted of a rectangular wooden vat, 6 ft. 6 in. long, 4 ft. 10 in. wide, and 5 ft. 3 in. high, with two electrodes, frame work and shafting, the cost of which was £30 7s. 6d., together with a dynamo, amperemeter, voltmeter, and shafting, etc., costing £24. The installation was capable of supplying six vats.

Forty ox and cow hides from the Brussels *abattoir* were experimented upon, weighing, without the horns, 1,380 kilogrammes. These hides, after having been put in lime, unhaired and fleshed, were swelled and colored.

The forty butts derived from these hides were hung up in vats on October 12, 1891, and taken out on November 16. They were subjected to the action of electricity during four weeks, or 24 days, from six to seven hours each day. The weight yielded, when finished and dry, was 379 kilogrammes.

The offal, bellies, throats, heads, hung up in the vat on November 16 were taken out on December 7. These parts were, therefore, subjected to the action of electricity during three weeks, or 18 days, from six to seven hours per day, and the weight yielded when finished and dried was 344 kilogrammes.

The forty hides, therefore, with a given weight of 1,380 kilogrammes, gave a total weight of finished leather of 723 kilogrammes, or $52\frac{4}{10}$ per cent.

The tanning materials employed to swell, color, and tan these forty hides were as follows:

		£	s.	d.
880 kilos.	oak bark	5	5	6
85 "	mimosa bark	1	7	0
700 "	oak extract	6	8	0
		13	0	6

No details are available as to strength of current supplied during these operations, nor to the cost of driving the dynamo, labor, etc.

Magic Picture.

This is the contrivance of F. Tschofen, of Vienna, Austria. It consists in an apparently blank piece of glazed paper or card or other suitable material which, on being rubbed over with colored pencils or crayons, or with colored powders or the like, produces pictures or words—such as answers to questions—visibly printed above.

A piece of glazed paper, card, or other suitable material is inscribed with letters or words or pictures, preferably in outline, either drawn, written, or printed with a mixture of finely powdered chalk, water, and gum arabic, or of any suitable mixture which is capable of imparting to the said lines a rough surface. Such inscriptions will, on being dried, be totally, or at least almost, invisible, but on rubbing the card, etc., thus prepared with colored crayons, powder, etc., the latter will adhere to the roughened lines, but not to the glazed surface of the card, thus bringing out the inscription or picture.

A Rain of Mud.

On April 4 there was a shower of mud along the Union Pacific Railway at Onaga. The rain commenced early in the day, and soon the south and east sides of all houses were covered with yellow clay. The windows received such a coating as to shut out the sun's rays.

A Union Pacific train which ran through the storm had its windows covered, and the headlight was so completely plastered that the light was shut in and the train ran in darkness to Rossville, the next station, where the mud had to be scraped off.

This storm lasted until after daylight. As far east as Topeka, the windows showed that the edge of the mudstorm had extended this far. It was more severe about fifty miles northwest.

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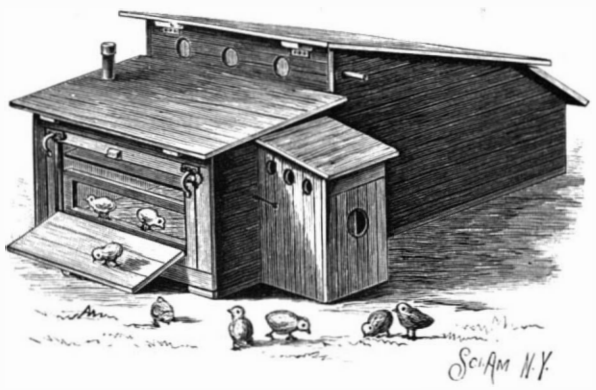
AN IMPROVED POULTRY BROODER.

The chicken brooder shown in the illustration is designed to keep the chickens provided with the requisite amount of heat and moisture, and also give them the necessary chance for exercise, while it is so made that it can be readily taken down and packed in small space for shipment. The picture represents a rear view of the brooder, the main coop of which is heated by the waste heat from the brooding chamber, the latter being a supplemental room built on to the back of the main coop. The main coop and the brood-

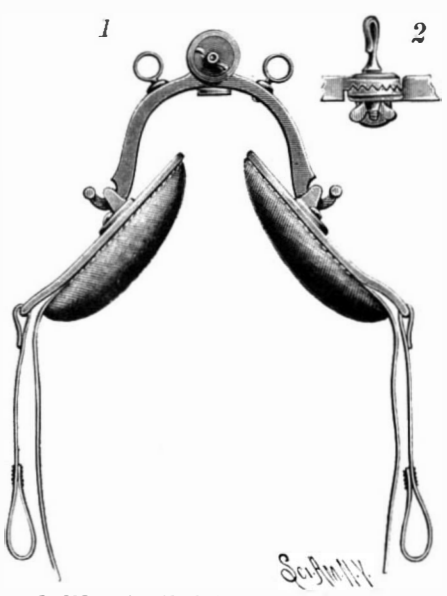


BARNEY'S POULTRY BROODER.

ing chamber are separated by a vertical partition, near the bottom of which is a transverse channel for the passage of air from the outside to the brooding chamber, and between the chamber and coop is a curtained aperture by which the chicks may pass to the coop. At one end of the brooding chamber is a small house containing a suitable heater or boiler, the boiler being connected with circulation pipes extending through the brooding chamber above and below the brooding tray. Supported on the pipes beneath the brooding tray are large flat tanks of water, which evaporates slowly, and the air passing up through the chamber and into the main coop is thus properly laden with moisture. It is designed that the heat shall thus be applied to the chicks much as if they were hovered by a hen, the main coop, receiving its heat only from the brooding chamber, being comparatively cool, and affording a suitable place for exercise, the rear door of the brooder being allowed to remain open, as shown, only for examination or when the chickens have become quite large. This construction is designed to afford a very large brooding surface for the number of chicks, and to brood up to market size the number first placed in the brooder. Having the air properly charged with moisture, and a perfect system of ventilation, it is adapted to successfully brood strong, healthy chickens. This improved brooder has been patented by Mr. Earl Barney, Schenectady, N. Y.

AN EASILY ADJUSTABLE HARNESS SADDLE.

A saddle which may be easily adjusted to fit horses of different sizes, which can be cheaply made, and will be strong and durable, is shown in the accompanying illustration, and has been patented by Mr. James A. Jamison, of Russellville, Ark. It has an upwardly



JAMISON'S HARNESS SADDLE.

curved center yoke which can by no possibility hit the back of the animal, this yoke comprising two members which terminate at their upper ends in nearly circular pieces, having interlocking teeth on their adjacent faces, as shown in the sectional view, Fig. 2. The clamping pieces are held together by a bolt which has a check hook on its front end, there being a thumb screw on the rear end of the bolt. A plate bent to form a loop to which the back strap may be conveniently secured is also held in position by the clamping pieces. The lower ends of the members of the center yoke are held in keepers on the pad plates, the latter forming the backing of pads of the usual construction. The lug straps are attached to the lower ends of the pad plates, and the belly girths are secured between the pads and pad plates. Owing to the pivotal connection between the yoke and the pads, the saddle will fit any horse, being made more or less open for larger or smaller horses by means of the adjustable connection between the members of the yoke.

The Jack Rabbit Plague in California.

On the San Joaquin plains of California the jack rabbits are a nuisance, and the practice of the farmers is to thin them out by annual drives. A corral is formed with barbed wire fence, and around this, forming a circumference ten to twelve miles long, from 5,000 to 7,000 persons collect at the appointed time. Many are mounted, there are many hundreds of light wagons and other vehicles, the mass on foot form a skirmish line in advance, provided with clubs. As the line contracts the jacks are put up and headed for the corral. Marshals so direct the advance that the animals are massed on the opened side of the corral. The close of the latest drive is thus described by the *San Francisco Examiner:* "Before the contracting line of men, women, boys and girls lay about 500 acres of plain so thick with madly rushing hares that the ground was actually hidden from sight.

"Within a space of a few acres over 25,000 rabbits were huddled together. In one place the terror-stricken mass had rushed into one corner and lay there over a foot deep. It is estimated that at least 3,000 were never touched by club, but were simply smothered to death by the rush of those in the rear. Photographs were taken of the mass as they lay huddled up, and then the veteran guard of California, clubs in hand, were formed in line of battle, and with a yell moved down upon the mass of 25,000 bunnies, clubbing as they ran. A sickening slaughter took place, lasting about an hour."

Steam as an Agent in Causing the Spread of Diphtheria.

In a discussion on diphtheria, published in the *British Medical Journal* for September 19, 1891, Dr. Russell cited several instances in which steam had seemed to be an active factor in the propagation of the disease. Hot water and steam from a brewery were introduced into some old cesspools and evidently wakened into activity germs which, if undisturbed, would have remained dormant. An epidemic of diphtheria soon developed in the vicinity, and was not checked until the steam was turned into other channels, when it quickly ceased. If, as we now believe, the bacillus of diphtheria develops with special rapidity in the presence of warmth and moisture and absence of light, it is not unreasonable to suppose that the introduction of hot water or steam into cesspools or sewers may be a most dangerous procedure. The maintaining of a considerable degree of heat in sewers can certainly not be wise from a hygienic point of view. Yet this condition prevails quite largely in New York, where sewers and water pipes are in many places kept at a continuous high temperature by the close proximity of the pipes of the steam heating companies. No more favorable medium for the culture of micro-organisms could be found than warm sewage. Given an imperfect trap and a vulnerable mucous membrane, and an attack of diphtheria is almost assured.

A NINE-INCH SCREW CUTTING LATHE.

The lathe shown in the illustration swings 9 inches over shears and 7 inches over carriage, and is made in three lengths, to take 27, 39, and 51 inches between centers. The head spindle is made of 1⅜ inch steel, having a ½ inch hole its entire length, and runs in gun metal boxes. The tail stock has an adjustable side movement for turning tapers. The rest is adjustable for taper boring or ball turning, and will swivel to any angle, permitting the use of the tool in any position. This lathe is adapted for turning iron, steel, brass, bone, wood, or ivory. It is manufactured by the Sebastian Lathe Co., Cincinnati, Ohio.

Collodion Varnish.

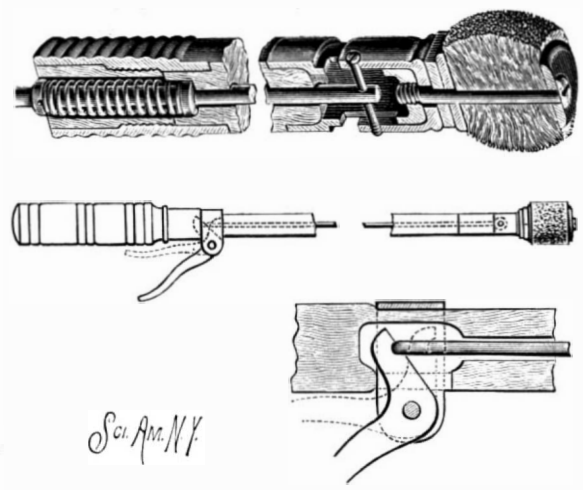
Hale's formula is as follows: Amyl acetate, 4 gallons; benzine (coal naphtha), 4 gallons; acetone, 2 gallons; pyroxyline, 2½ pounds. The different ingredients are mixed and the pyroxyline dissolved therein.

The metal article, having its surface polished and made free from water and grease by any ordinary or suitable means, is or may be dipped into a solution made according to either of the formulæ and on removal therefrom suspended in a chamber out of the draught till the adhering coat or film dries or hardens, which takes place in about fifteen or twenty minutes. The drying may be hastened by artificial heat, and while the use of such heat at any stage of the process is not inconsistent with the invention, yet it is preferred to operate in the cold—that is, at ordinary temperatures. In damp weather the coating should be dried at a temperature of say 100° to 105° Fah. The varnish or solution may also be applied by brushing.

The coated articles when the coatings are dry have their metal surfaces provided with a substantial, even, hard, thin, smooth, impervious, and transparent film of pyroxyline of sufficient tenacity, adhesion, and durability practically to resist the handling and exposure to which lacquered articles in general are subjected.

AN IMPROVED GUN CLEANING DEVICE.

A gun swab or cleaner which can be adjusted by direct or independent pressure to any required size, to be made to bear against the sides of the barrel after the cleaner has been put into the gun, is shown in the accompanying illustration, and has been patented by Mr. George H. Garrison, of Sumas, Washington. The top view represents in section the forward end of the cleaner, the second figure being an exterior broken view. It comprises a tubular outer rod or stick and an inner longitudinally movable rod, both made in

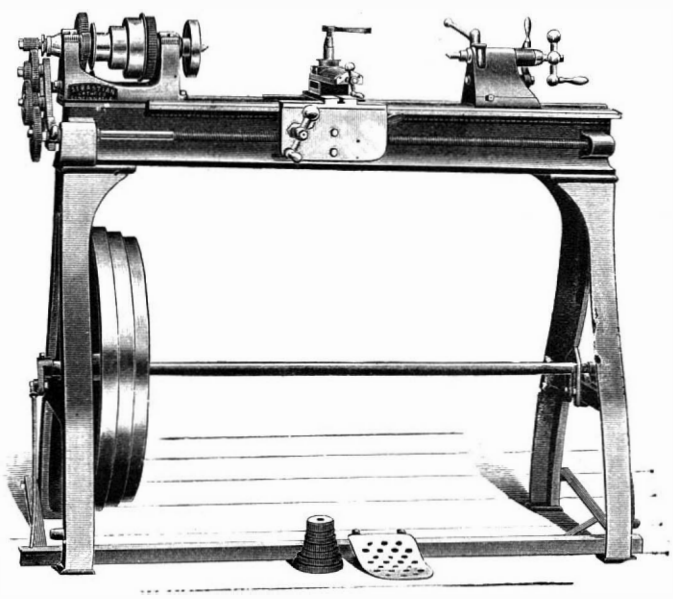


GARRISON'S GUN CLEANING DEVICE.

three sections or lengths, with the swab on the forward end of the front outer member, and a lever applied to the rear member or handle portion, as shown in the bottom figure, for moving the inner rod forward to give the necessary pressure to and lateral distension of the swab. The members are detachably connected by screw-threaded metal ferrules, and the front member has a cap-like ferrule to receive over it a longitudinally sliding compressing ferrule, which, when forced forward, produces lateral distension of the swab, as shown in the top view. The swab or cleaner is of felt or other soft and flexible material, a screw passing centrally through it and engaging at its inner end with the cap-like ferrule, so that when the sliding compressing ferrule is forced outward the swab will be expanded. Instead of a felt swab a cloth-covered rubber one similarly bound and held might be used, or a split metallic or other form of swab, the direct expansion of the swab after it has been put into the barrel being produced by the longitudinally movable inner rod. Any standard gun cleaner can be used on the outer rod if desired, without the inner rod direct-pressure attachment.

A New Tin Alloy.

An alloy of 95 parts of tin and 5 parts of copper will connect metals with glass. The alloy is prepared by pouring the copper into the molten tin, stirring with a wooden mixer, and afterward remelting. It adheres strongly to clean glass surfaces, and has nearly the same rate of expansion as glass. By adding from one-half to one per cent of lead or zinc the alloy may be rendered softer or harder, or more or less easily fusible, as required. It may also be used for coating metals,



AN IMPROVED SCREW CUTTING LATHE.

imparting to them a silvery appearance. — *Phar. Record.*

ONE million persons are employed by the railroads of the United States.

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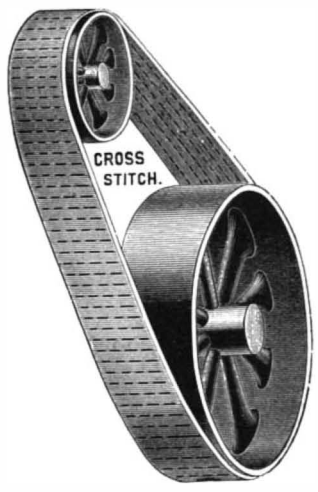
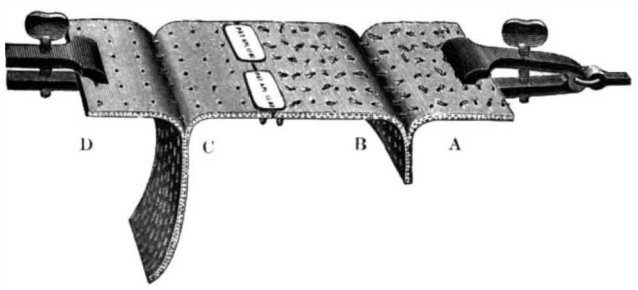
IMPROVEMENTS IN RUBBER BELTS.

Every year advances have been made in the manufacture of rubber belting, with the object of making a belt that will better stand the enormous strains and hard work to which belting is now put. When belts were first put on the market the different plies of which they were made up were held together by the strength of the rubber which is kneaded into the meshes of the duck, but that failed to serve the purpose, so that recently the best belts have been sewed through and through, thus holding the various plies together very solidly. It has been found, however, that these sewed belts are far from perfect. A recent improvement in this direction is called the "cross-stitch" belt, on account of the method of its manufacture, and it is the subject of several patents. The old style sewed belt is sewed with an ordinary sewing machine, one thread at a time; consequently, the threads on both sides run longitudinally, the length of the belt. In the "cross-stitch" belt all the threads are sewed at once. The threads on side run longitudinally, while on the other side they are tied together by threads running transversely, as is shown in the accompanying cut.



CROSS STITCHED RUBBER BELTS.

All who have had experience with sewing machines of any kind know the difficulty of getting an even tension on the thread at all times, and in the old style of belt it is practically impossible to have all the threads of the same tension. The result is that a portion of the threads take all the strain of the entire belt, for the tighter the tension on any particular thread, the tighter the thread and the more strain on that thread. On the "cross-stitch" belt all of the longitudinal threads are tied together by the under transverse thread, so that if one thread happens to have a tighter tension than the others, the under thread equalizes it with the others, so that the entire number of threads have identically the same tension.



TESTING STRENGTH OF RUBBER BELTS.

By the very nature of its construction, also, the threads running across the "cross-stitch" belt are in a perfectly straight line, because all the needles are fixed to a single steel bar. This results in making the "cross-stitch" the strongest sewed belt possible, as can be seen by examining carefully the above cut, and making the test yourself.

Take any sewed belt, separate the plies as in the cut A B; separate the plies in the "cross-stitch" belt C D; clamp the two ends B C together, attach clamps to the ends A D, then apply power to A and D to pull them apart. This experiment will illustrate how strongly the threads hold, and that the "cross stitch" will rip open the other belt. The reason of this is that in the "cross stitch" the transverse threads are in a perfectly straight line of necessity, and in the other belt the chances are that only a portion of the threads would be in the same straight line at right angles to the line of the belt, because each line of threads is sewed separately.

Another objection to the old style sewed belt is that when the belt runs over a small pulley, the strain on the outside threads of the belt is very great, and they either break or weaken the belt by cutting into the duck. The thicker the belt, the more danger in this respect. In the "cross stitch" the transverse threads run on the outside, and this difficulty is overcome. They have these belts now in operation which have not had to be taken up once after being put on. For any further information regarding them, address the manufacturers, Boston Woven Hose and Rubber Company, No. 275 Devonshire Street, Boston.

California Trees.

A. H. Taylor, representing the Interior Department at Washington, visited Tulare recently for the purpose of arranging for a section of sequoia, to go to the World's Fair. The *Pacific Lumberman* says the Tulare Board of Trade decided to undertake to procure a fine tree, and, if the cost is not too great, the government will exhibit it in the government building at Chicago, and afterward put it on permanent exhibition at the Smithsonian Institution at Washington. The section of the tree will be at least twenty feet high, and thirty feet through.

Mr. Taylor will take a tree, thirty feet long and thirty feet through. His plan is to have it cut into slabs, three feet thick, for transportation. Two sections of the full diameter of the tree will be cut, and polished so as to show the grain completely. The outside of the tree, in these three-foot slab sections, will be taken to Chicago, put together, and formed into a complete, though hollow, tree. The polished ends will be the floor and ceiling.

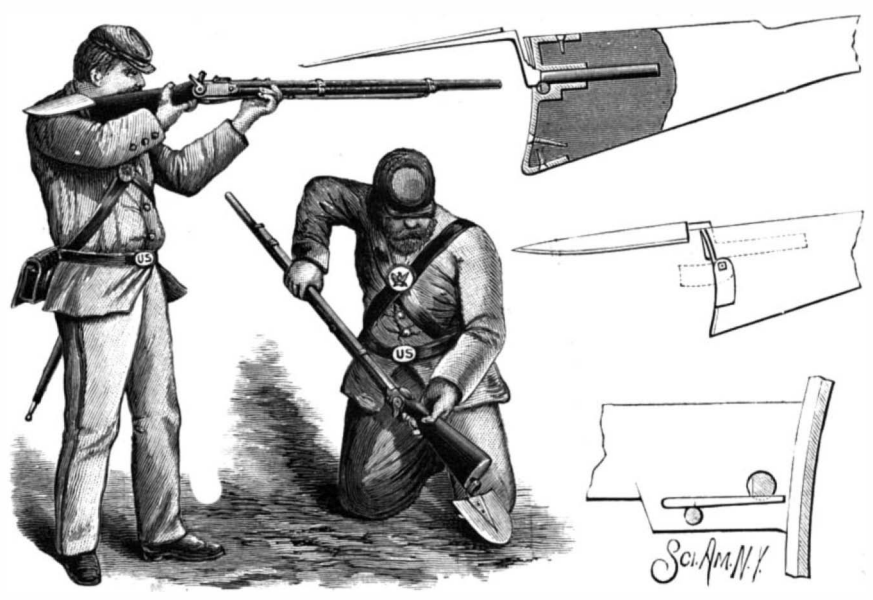
Inside, will be pictures of other trees and California scenery. It will be twenty feet, or over, across in the inside.

Colors in Tempering Iron.

Investigation as to the cause of the production of colors in tempering iron satisfactorily shows it to be due to the formation of thin films of oxide on the surface of the metal when it is heated in the presence of air. It also appears from recent researches that the oxide so produced is practically transparent, first, because the sequence of colors is what would be expected in films of a transparent substance when the thickness of the films gradually increases; also because of observations on the reflected light, the color of which varies somewhat at different angles; but chiefly because it is found that on increasing the temperature a little above the point necessary to produce a dark blue, the color gradually disappears, and the surface, though covered with more oxide, becomes almost colorless again. The colors being the result of oxidation, it is probable that the nature of the surface to be heated, its freedom from any soiling, and the length of time during which it is heated must exert a considerable influence on the shade produced.

AN INTRENCHING TOOL FOR SOLDIERS.

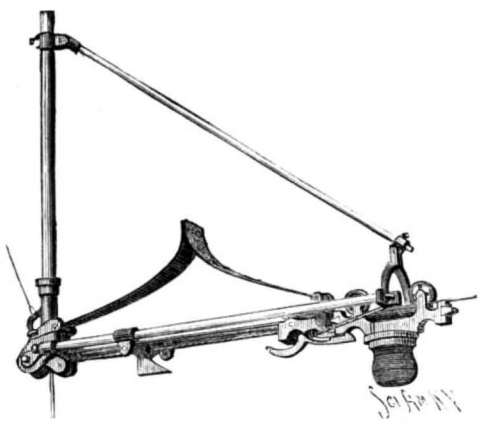
A tool adapted for use on the butt of a rifle or carbine in throwing up earthworks, digging rifle pits, etc., and which may also be used as a spade independently of the gun, is shown in the accompanying illustration, and has been patented by Mr. William H. Hamner, of Fort Assinaboine, Montana. The tool has a shovel blade, from which extends, at a slightly different inclination, a threaded part adapted to be screwed into a hollow handle, in which may be carried a screw driver, shell extractors, etc., the outer end of the handle being closed by a cap. To conveniently attach the tool to the rifle the handle is passed through a sleeve projecting inwardly into the wooden portion of the butt from the heel or base plate, as shown in the sectional views. To prevent the turning of the handle in the sleeve, there is a bolt in a transverse recess directly below the handle. To lock the bolt a spring is secured on one side of the sleeve to engage with its free end two shoulders formed at the inner end of the bolt. When the tool is fastened to the butt of a gun the back of the blade extends about in line with the top of the butt, and the soldier is not hindered from using the piece in case of emergency, the top of the blade then resting on the shoulder. In place of the handle shown, a telescopic handle may be used, and when this is extended the tool forms a regular shovel without the gun. When the tool is not to be used in connection with the gun, it may be carried in a loop on the soldier's belt.



HAMNER'S INTRENCHING TOOL.

AN IMPROVED CASH CARRIER.

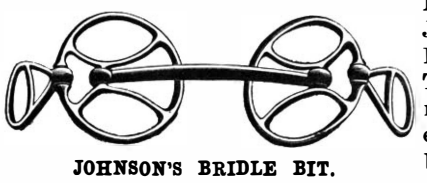
The illustration represents a new device for the conveyance of cash from the sales counter to the cashier's desk, recently patented by Mr. Joseph Starr, of New London, Ct. In the design of this machine all superfluous attachments have been omitted, and it is reduced to the practical and useful. With this machine the car is propelled along the wire by the use of a steel bow spring, which, as will be readily understood, is superior to rubber bands and cord combinations, for rubber soon loses its force, and the cord combinations are essentially the same as a hand push carrier, for the same calculation must be used to regulate the speed of the cash car. In the Starr carrier there is nothing to do but pull the cord, the spring does the rest; and by the use of the adjustable tripper the force and distance of the throw can be regulated to a nicety. Not only will this machine throw the car along the *level wire*, but will throw *up* grade also, which makes it very convenient for those who desire to have their cash desk elevated. To this propelling machine a basket is also adapted for carrying parcels. These machines are manufactured by the Starr Cash and Package Car Co., of New London, Ct.



THE NEW STARR SPRING CASH CARRIER.

AN IMPROVED BRIDLE BIT.

The accompanying illustration represents a bridle bit of novel construction which has been patented by Mr. Bernt M. Johnson, of Racine, Wis. The cheek rings are pivoted to the bit bar, which is a single one, and the rings may be used to produce pressure when required on the sides of the lower jaw of the animal, at the option of the driver, as there are pivoted to them independent rein pieces to control the action of the rings and bit generally. When the animal is not a vicious one, the free ends of the rein pieces are united by the ends of the reins with the inner portions of the cheek rings, so that the pull is at right angles to the bit bar, and the rein pieces do not protrude from the faces of the cheek rings; but inusing the improvement with a vicious horse, the ends of the reins are attached only to the back or free ends of the rein pieces, the pull upon the reins then pressing the inner portions of the cheek rings in against the jaws of the animal.



JOHNSON'S BRIDLE BIT.

Fuel for the World's Fair.

When bids for furnishing fuel for the World's Fair were opened March 19, the Standard Oil Company was found to have the lowest bid, on the basis of three barrels of fuel oil being equal to a ton of coal. The Standard Oil Company offered to furnish oil at the rate of 70 cents for a barrel of 42 gallons during 1892, and 72½ cents a barrel during 1893. Most of the fuel, of course, will be used in 1893. Various estimates have been furnished of the amount of coal necessary to keep the wheels going around. The lowest estimate was 75,000 tons. On that basis the big oil trust would deliver 225,000 barrels of oil at Jackson Park. The bids for coal were as follows: Weaver, Getz & Co.—Shawnee coal, No. 1 at $2.44 per ton; No. 2 at $2.38. Roods & Ramsey Company—Little Mud Creek lump at $2.60. New Pittsburg Coal and Coke Company, $3.08. Silver Creek and Morris Coal Company, $3.95. Officials of the fair have not decided yet whether to use coal or oil for fuel. The Standard Oil Company have produced statistics to show that oil is cheaper, more convenient, and cleaner. They agree to deliver the oil as wanted, and to relieve the Exposition Company of the necessity of furnishing large warehouses, as would be necessary in case coal were used.

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Automatic Sprinklers.

From a recent circular issued by the Boston Manufacturers' Mutual Fire Insurance Company, we learn that automatic sprinklers were placed over the whole of three cotton mills, except the weaving, by Col. T. J Borden, of Fall River, in 1874. The system was adopted in a few other mills, without any urgent suggestion from the underwriters, in subsequent years to 1877 inclusive. In 1878, the officers of this company became satisfied that it would become the most efficient safeguard against the increasing hazard of our risks, and should be steadily presented for general adoption. The most thorough tests and experiments were then made upon automatic sprinklers by C. J. H. Woodbury, C.E., now one of the vice-presidents of this company, under whose supervision most of this report has been prepared. The result of this work has been largely in suggesting improvements upon automatic sprinklers, and preventing the acceptance as unsuitable for protection against fire of many varieties containing serious defects.

The true measure of the value of automatic sprinklers as a protection against fire is best shown by the experience of this company for fifteen years, on property where this company has shared in the insurance.

The introduction of automatic sprinklers has reduced the average loss per fire, within the experience of this company where they were in service, to 8·3 per cent, and the average loss per claim to 6·9 per cent of what it is apparent that such fires and claims might have been under the previous conditions of protective apparatus. But any classification must be made on arbitrary divisions, and the proportions of each class might be differently placed by another, yet in any case the result would show a very great reduction of fire loss.

Automatic sprinklers have their limitations and may not stop a fire which starts elsewhere and burns to the room where they are installed, although there have been many instances where they performed valuable service under such conditions.

They are not suited to the protection of large open spaces, or to deep piles of combustible material. Manufacturing processes generating corrosive vapors, or producing adhesive deposits upon automatic sprinklers, impair their efficiency.

Exercise for Lame Horses.

The Breeder and Sportsman, of San Francisco, describes the swimming tank on the famous Souther ranch in California. It is built of concrete and is about eight feet deep, 30 feet wide and 90 feet long. There are suitable pipes for filling and emptying it and facilities for warming the water. The horse is taken in and out from the platform shown at one side. Salt water is frequently used, as it acts like a tonic on the horses. In swimming the horse takes the same or even more violent exercise than he would trotting on the track, while there can be no injury to the feet or limbs. It has frequently happened that famous race horses have been taken lame during the season—so lame that it was necessary to give them complete rest for fear of injuring their feet, as they surely would do if exercised on a hard track. When these horses went lame it was of course supposed that their season was ended, for two or three weeks of idleness would surely unfit them for rapid work. It was a great surprise, therefore, when they turned up in perfect training and entirely over their lameness. At first there was a great mystery about the treatment, but it was soon learned that the horses were made to swim every day, thus giving them all the work they needed and at the same time preventing injury to the hoofs by striking on the hard track.

Plating the Monterey.

The armor plating of the Monterey is now in progress at the Union Iron Works, San Francisco. The plates are finely finished, their outside surfaces being as smooth as glass.

They are 24 feet long, and vary in thickness from 14 inches to 7 inches. The outside surface of the armor is moulded so as to preserve the line of the ship's side. The inner surface is curved, being thicker at the water line than at the main deck, and also diminishing in thickness toward the lower edge. The inner surface of the armor plate will be backed by hard wood, varying from 4 to 7 inches in thickness.

The plates are drilled to receive 2½ inch bolts. These bolts pass through the armor plate, then through the sheathing and the vessel's side plate, and are to be fastened by screw bolts on the inside. In addition to these fastenings long bolts will be passed through the armor plate in a vertical direction. The upper ends of these bolts will be fastened to the steel plate beneath the main deck, and the lower end to the angle plate on the vessel's side, specially prepared for it. Between 3,500 and 4,000 pounds of bolts will be used to secure each plate in position.

The two plates just received are two of the smallest that will ultimately form the Monterey's armor. They will all be about the same average thickness, and will vary in length from 24 feet to 32 feet. The weight of the heaviest of the armor plates will be 40,000 pounds. When finished it is estimated that not less than 1,500,000 pounds of steel will have been used for the total armor plating of the Monterey.

DECISIONS RELATING TO PATENTS.

Supreme Court of the United States.

ANSONIA BRASS AND COPPER COMPANY *vs.* ELECTRICAL SUPPLY COMPANY.

Decided March 14, 1892.

Letters patent No. 272,660, issued February 20, 1883, to Alfred A. Cowles, for an insulated electric conductor, *Held* invalid.

The application of an old process or machine to a new and analogous purpose does not involve invention, even if the new result had not before been contemplated.

If an old device or process be put to a new use which is not analogous to the old one, and the adaptation of such process to the new use is of such a character as to require the exercise of inventive skill to produce it, such new use will not be denied the merit of patentability.

Where a patent sued upon describes a method which differs only in degree and not in kind from a previously employed method, and where the utmost that can be said of the patented process is that it produces a somewhat more perfect article than was previously produced, *Held* that the patented method involves no novelty within the meaning of the patent law. (Citing Smith *vs.* Nichols, 21 Wall., 112.)

Appeal from the Circuit Court of the United States for the District of Connecticut.

STATEMENT OF THE CASE.

This was a bill in equity for the infringement of letters patent No. 272,660, issued February 20, 1883, to Alfred A. Cowles, for an insulated electric conductor.

His method of preparing the wire was stated in his specification substantially as follows: The wire was first passed through a braiding machine, and a layer of cotton or other threads braided about it. The covered wire was then passed through a vessel containing paint, preferably white lead or white zinc ground in oil and mixed with a suitable drier. A second braiding was then applied directly upon the fresh paint; the threads thus braided upon the paint force the paint into the first braided covering, and at the same time the paint oozes through between the threads. In this way the paint was incorporated throughout the braided covering and filled up the pores; and the wire thus perfectly insulated, and there was no possibility of inflaming the covering.

The most satisfactory evidence of the prior use of a non-combustible covering for electric wires is found in the testimony of Edwin Holmes, manufacturer of an electric burglar alarm.

The method described by Cowles differs only in degree and not in kind from that described by Holmes. In other words, it is a more thorough doing of that which Holmes had already done, and, therefore, involving no novelty within the meaning of the patent law.

U. S. Circuit Court of Appeals—Ninth Judicial Circuit.

REGAN VAPOR ENGINE COMPANY *vs.* PACIFIC GAS ENGINE COMPANY *et al.*

Decided January 30, 1892.

An instrument purporting to assign an invention yet to be made does not operate as an assignment of such invention when made, but is a mere executory contract.

An indorsement of such an instrument assigning and transferring all "right, title, and interest in and to the above agreement" passes only the written instrument itself, with such right of action thereon as had not at the time of the indorsement become vested in the indorser. (Reversing Regan Vapor Engine Co. *vs.* Pacific Gas Engine Co., 57 O. G., 1886.)

Appeal from the Circuit Court of the United States for the Northern District of California.

On May 15, 1886, Regan and Garratt entered into an agreement wherein they stated that we "do hereby license and grant and convey each to the other," throughout certain States and Territories, the license to Garratt being for the Pacific coast—

"All such inventions and improvements, whether patented or not, which may be hereafter made by either of us—"

in gas engines and the mechanism by which they are operated.

The lower court decided that the Regan-Garratt agreement of May 15, 1886, operated as an assignment of an invention which Regan three years afterward, on August 6, 1889, made and secured a patent for, as well as the patent issued on April 1, 1890, the same being a reissue thereof, and which was issued to and in the name of the appellant. Accordingly a decree was entered which in effect decides that the appellant has no title to the patent in suit for the Pacific coast and that the Pacific Gas Engine Company has.

The agreement of May 15, 1886, is not the assignment of a patent, though it contains language—"grant and convey"—sufficient for that purpose, if there was anything to assign. It may be good as an agreement to sell and assign a future invention, but it cannot operate as a sale or assignment of such an invention even when made. No one can sell that which he hath not. (Comyn's Dig., tit. "Grant," D.) A man cannot grant all the wool that shall grow upon his sheep that he shall buy afterward, for there he hath it not actually or potentially. (Bac. Abr., tit. "Grant," D.)

Chancellor Kent says (2 Comm., 468):

"The thing sold must have an actual or potential existence, and be specific or identified, and capable of delivery; otherwise it is not strictly a contract of sale, but a special or executory agreement. . . . But if the article intended to be sold has no existence, there can be no contract of sale."

Benjamin, in his work on sales (sec. 78), says:

"In relation to things not yet in existence, or not yet belonging to the vendor, the law considers them as divided into two classes, one of which may be sold, while the other can only be the subject of an agreement to sell—of an executory contract. Things not yet existing, which may be sold, are those which may be said to have a potential existence; that is, things which are the natural product or expected increase of something already belonging to the vendor. A man may sell the crop of hay to be grown on his field, the wool to be clipped from his sheep at a future time, the milk that cows will yield in the coming month, and the sale is valid. But he can only make a valid agreement to sell, not an actual sale, where the subject of the contract is something to be afterward acquired, as the wool of any sheep, or the milk of any cows, that he may buy within the year, or any goods to which he may obtain title within the next six months."

A man may make a valid agreement to sell an invention not yet made by him, but he cannot make a valid sale thereof.

Curtis on patents (sec. 160) says:

"The statutes, however, which authorize the assignment of an invention before the patent has been obtained appear to embrace only the cases of perfected or completed inventions. There can, properly speaking, be no assignment of an inchoate or incomplete invention, although a contract to convey a future invention may be valid, and may be enforced by a bill for specific performance. But the legal title of an invention can pass to another only by a conveyance which operates upon the thing invented after it has become capable of being made the subject of an application for a patent."

Mr. Robinson, in his work on patents (vol. 2, sec. 771), says:

"A contract for the transfer of inventions not yet in being is valid as a contract, but is not an assignment. The subject matter of an assignment is an existing invention, not only conceived as an idea of means, but actually reduced to practice, and thus invested with the inchoate or perfected right to that monopoly which must always pass with the invention in this form of conveyance. An intended or incomplete invention rests merely in purpose and expectation. It does not clothe the proposed inventor with any special privileges or entitle him to any special rights in the monopoly which, if his purposes were accomplished, he might be able to secure. The transfer of such future inventions is a mere executory contract to assign them if they happen to be made."

To this general rule there appears to be one exception, and that is where a patentee assigns a patent already issued, together with all future improvements thereon. It has been held that such assignments pass the title to the future improvements.

But that is not this case. Here there is no assignment of a patent with any improvements thereon. The document which constitutes the basis of appellees' claim is at most an attempted assignment of any independent inventions to be thereafter made by either of the contracting parties in gas engines.

The decree of the circuit court is reversed, and the case is remanded with directions to affirm the master's report.

Commissioner's Decisions.

HISEY *vs.* PETERS.

Decided March 11, 1892.

In an interference between a patent and an application, where the question was not one of independent origination, but a dispute over the invention of the specific thing patented, the natural presumption existing in favor of validity of the patent is greatly strengthened by the fact that the junior party to the interference had full knowledge of the patentee's proceedings before the office, but was fifteen months behind him in filing his application.

Where a skilled workman is employed to embody an inventor's idea in practical form, the results are the property of the inventor unless they show that the workman has discarded the original idea and proceeded upon a wholly distinct and separate plan.

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A LARGE REFRIGERATING MACHINE.

Engineers, journalists, and those specially interested in refrigeration and the manufacture of ice, through the courtesy of the De la Vergne Refrigerating Company, were recently enabled to visit the new and extensive works of the company, at the foot of East 138th Street, upon the East River, and to inspect a very large refrigerating machine just completed and ready for shipment to The Anheuser-Busch Brewing Association, of St. Louis, Mo., who will use it for the purpose of cooling beer. This machine has a cooling capacity equal to that resulting from the melting of 500 tons of ice in twenty-four hours, which is much greater than that of any machine heretofore constructed. The machine is not only the most modern and most powerful one of its kind, but it is also a splendid example of engineering skill, and a superb piece of mechanical execution.

Before describing the construction of the machine, it is perhaps well to outline the general principles upon which the machine operates.

The refrigerating agent employed in this engine is anhydrous ammonia. This agent is charged into the system, and afterward passed through the round of the three operations, which are as follows:

First: Compression.—The agent in gaseous form is compressed to a pressure varying in the case of ammonia from 125 to 175 pounds per square inch, and depending upon the temperature of the condensing water used, either mechanically or otherwise, in order to prepare it for the second operation. During the compression, heat is developed in proportion to the amount of pressure exerted upon the gas, or to the relative volume to which it has been reduced. Expressed popularly, heat is squeezed out of the gas, and can then be carried away by the condensing water.

Second: Condensation.—The heat developed in the above operation is withdrawn from the compressed gas by forcing it through coils of pipe while said coils are in contact with cold water; the heat being transferred to the water surrounding the coils. When this point is reached the gas is ready to assume the liquid condition, and in so doing it gives off additional heat to the surrounding water.

Third: Expansion.—The liquefied gas thus obtained is allowed to enter coils of pipe so placed that the substance to be cooled (air, water, brine, beer, etc.) can be brought into contact with them, the pressure in the interior of these coils being maintained at a lower point than that required for retaining the gas in the liquid state. The liquefied gas, upon entering said coils, re-expands, and extracts from the pipes and the substances surrounding the pipes the same quantity of heat that was previously given up by the gas to the water used during the period of condensation and liquefaction. The gas, having performed in this last operation its refrigerating work, is now ready to repeat the same cycle of operations.

From what has been said it will be readily understood that a refrigerating machine consists of three series of parts, each corresponding to one of the above operations:

1st. *A compression side*, in which the gas is compressed, either mechanically or otherwise.

2d. *A condensing side*, generally consisting of coils of pipe, in which the compressed air circulates, parts with its heat, and liquefies; and

3d. *An expansion side*, consisting also of coils of pipe, in which the gas re-expands and performs the refrigerating work.

In order to render the operation continuous, these three sides or parts are connected together, the gas passing through them in the order named.

The gas is drawn through the expansion coils by the pumps at a pressure varying from 10 to 30 pounds above that of the atmosphere, where ammonia is in use, and is then forced into the condensers, where a pressure of 125 to 175 pounds per square inch usually exists; here liquefaction takes place, and the resulting liquefied gas is allowed to flow to a stop cock having a minute opening, which separates the compression from the expansion side of the plant.

The expansion side consists of coils of pipe similar to those of the condensing side, but used for the reverse operation, which is the absorption of heat by the liquefied gas, instead of the expulsion of heat from it, as in the former operation.

Heat is conducted through the expansion or cooling coils to, and is absorbed by, the expanding liquefied gas.

Either of the above methods can be applied to the refrigeration of breweries, packing houses, etc., and for the manufacture of ice, the same gas being used over and over again to perform the same cycle of operations. To maintain this cycle of operations powerful compressing pumps of peculiar construction are required.

Owing to the volatile nature of ammonia gas, the most perfectly constructed compressors, unless provided with some means for preventing the escape of gas, leak around the pistons and the piston rods. One of the important improvements in the machine made at these works is that of the injection of cold oil into the compressing cylinders along with the ammonia gas, the oil serving to seal the joints, prevent the escape of gas, and at the same time to increase the efficiency of the compressor by abolishing clearing spaces at the ends of the cylinder. By means of this improvement, it is made possible to use double-acting compressors, which greatly increase the capacity of the machine, without adding materially to the friction of the moving parts.

Although our engraving gives a good general idea of the dimensions of this machine, its size cannot be fully appreciated without the exact figures.

The double-acting compressing cylinders have a diameter of 24 inches and a stroke of 48 inches. The engine which drives the compressors is of the Corliss cross-compound condensing type, of 600 horse power; the high pressure steam cylinder is 32 inches in diameter, with a stroke of 48 inches: the low pressure cylinder is 64 inches in diameter, with the same stroke; the connecting rods are connected with the cranks on the engine shaft, which also receives the connecting rods of the compressors. The crank shaft is made of the best selected horseshoe scrap iron. It has a diameter of 15½ inches and weighs 20,820 pounds. On each of the crank cheeks is shrunk a band of wrought iron 2 inches thick. The crank shaft carries two fly wheels, each 14 feet 8 inches in diameter. The compressor connecting rods weigh 3,400 pounds each, and the steam connecting rods 3,800 pounds each. In the construction of this machine 4¼ tons of phosphor bronze were used in the connecting rods and bearings. The total weight of the machine in the rough was 390,000 pounds; the weight finished approximates 175 tons.

The anhydrous ammonia used in connection with these machines, and everything necessary for a complete plant for the manufacture of ice, is made here. The pipe fittings which are used in the construction of the coils and for connections, and which must necessarily be of special construction, are also made at these works.

Height and Position of Mount St. Elias.

The geographic position of Mount St. Elias is of popular interest in connection with the boundaries of Alaska.

In the convention between Great Britain and Russia,* wherein the boundaries of Alaska are supposed to be defined, it is stated that the boundary, beginning at the south, after leaving Portland Channel, shall follow the summit of the mountains situated parallel to the coast as far as the 141st meridian, and from there northward the said meridian shall be the boundary to the Arctic Ocean. Whenever the summits of the mountains between Portland Channel and the 141st meridian "shall prove to be at the distance of more than ten marine leagues from the ocean, the limit between the British possessions and the line of coast which is to belong to Russia, above mentioned, shall be formed by a line parallel to the windings of the coast, and which shall never exceed the distance of ten marine leagues therefrom."

As Mount St. Elias is approximately in longitude 140° 55′ 30″ west from Greenwich, as already shown, it is, therefore, only 4′ and 30″ of longitude, or 2½ statute miles, east of the boundary of the main portion of Alaska. Its distance from the nearest point on the coast is 33 statute miles. There is no coast range in southeastern Alaska parallel with the coast within the limits specified by the treaty, and the boundary must, therefore, be considered as a line parallel with the coast and ten marine leagues, or 34½ statute miles, inland. The mountain is thus 1½ miles south of the boundary and within the territory of the United States. Its position is so near the junction of the boundary separating southeastern Alaska from the northwest territory with the 141st meridian that it is practically a corner monument of our national domain.

The height of Mount St. Elias has been variously estimated. Prof. Russell, who was at the head of the government expedition which made a careful examination of the mountain last summer and reached the highest point yet attained by any one, estimates the height at 19,000 feet.

The Simplon Tunnel.

From particulars given in the *Moniteur Industriel*, it appears that the tunnel will be about 19,731 meters (12¼ miles) long, exceeding considerably the length of the Gothard tunnel, which is 14,900 meters or about 9¼ miles. The tunnel will consist of practically two distinct sections of about equal lengths, the north section 9,900 meters long, which will begin near Brigue, and the south section, about 9,800 meters long, which will terminate within a short distance from the station Isella. As of special interest, it is mentioned that over part of the south section there will be in reality two tunnels, each accommodating a single line of tracks, while the remaining length will be in the shape of a single tunnel with double tracks.

The power required in building the tunnel, for tunneling proper, ventilation, transportation of material, etc., will be supplied by two large hydraulic plants, one at each tunnel end. At the north end the water will be taken from the Massa, an appreciable head being attainable, promising, it is thought, a total of 2,950 horse power. At the south end something like 4,250 horse power is counted on, the water to be taken from the River Cairasca. The total cost of the tunnel and accessories has been figured up to fall not far short of 80,000,000 francs, or about $16,000,000.

* Message from the President of the United States, transmitting report on the boundary line between Alaska and British Columbia; 50th Congress, 2d session, Ex. Doc. No. 146, Senate, 1889. I. C. Russell.

Fireproof Doors.*

The danger from fire can be considerably lessened if passageways between buildings or through partitions be provided with doors that are as fireproof as possible. It used to be the fashion to provide iron sliding doors for such openings, but it was soon found that the iron door was faulty in construction and not much better than an ordinary wooden door would be. In a very few minutes the iron would become red-hot and warp out of shape so that a space of several inches would be opened around the door, letting fire have free entrance.

It has been found that covering a wooden door with tin proves more fireproof than an iron door; wood cannot burn unless exposed to the atmosphere. Placing a piece of wood in an air-tight tube, the tube may be heated almost red-hot without more than charring the outside of the wood.

To make a fireproof door, procure some sound, matched boards that fit closely together, free as possible from knots, many edges, or other imperfections. Make the door double, nailing the two thicknesses across each other, and fasten them tightly together by means of clinch nails put not over 6 inches apart in every direction. If the door be more than 4 feet wide or 7 feet high, better use three thicknesses of boards. Cover entire door with tin, locking the seams, not soldering them, and nailing each strip of tin firmly to the door. Do not drive nails through the tin to fasten it, but put a clip of tin into each seam lock, driving the nail through this clip, then lay on another strip of tin and another set of nailed clips, and so on entirely around the door.

Work right around the door from one side to the other, pressing over the edges, locking tightly and hammering all seams flat. Cover top and bottom of the door in the same manner, being particularly careful about top of door that the tin is locked perfectly. A small opening here will allow smoke and gas to issue, forming a draught between door and tin which will permit fresh air to draw in to the bottom of the door, and soon destroy the wood.

Be particular that no air spaces are left in the door. Therefore, never try to cover a panel door with tin, for such construction will not stand fire. It is better not to use hinges with such a fire door; put on sliding trucks or hang the door upon a track. Such a door should always fit into the rabbet in the door frame and come flush with the wall when practicable.

If the door slides, let it pass in behind a jaw which will press it snug, so as to tightly close the openings into either room.

No nails less than one inch long should be used in fastening the tin. The wood may be charred to a considerable depth, and if short nails are used they will become detached and allow the tin to bulge off, forming a bare place in the door, which may lead to its destruction.

Under these conditions the surface of the wood is converted into charcoal, which, being a non-conductor of heat, tends to retard further combustion of the wood; but if air get in in any manner, the charcoal is quickly burned, and then the door itself will be destroyed.

This shows how it does not pay to tin a door only on one side, for when this is done, as soon as the heat is sufficient to convert the surface of the wood under the tin into charcoal, oxygen reaches it from the other side of the door and the whole business is quickly in a blaze.

Several devices have been made to automatically close such fire doors, whenever the atmosphere reaches a certain degree. One method is to hold the door open by a thin wire of fusible metal which melts at 180 or 190 degrees. Another method is to use an electric device connected with any good automatic fire alarm system. Either of the methods has its advantages and faults. The advantages are that they work well when in good order, and the disadvantages are that they are hardly ever in good order. In a sawmill or woodworking shop in particular, a door that is kept open many days, weeks, and even months becomes so packed around with sawdust, to say nothing of chips and thin strips of wood, that a pair of mules could scarcely close the door, much less will it glide into place with its own weight when the time for action comes.

The best way to close fire doors is to make it some one's duty to see that they are kept shut, especially at night. When the mill is vacant it should be some one's duty to close them at the first alarm of fire, and the same man should see that the doors are in good condition and will work at all times.

* James L. Hobart, in the *Industrial American*.

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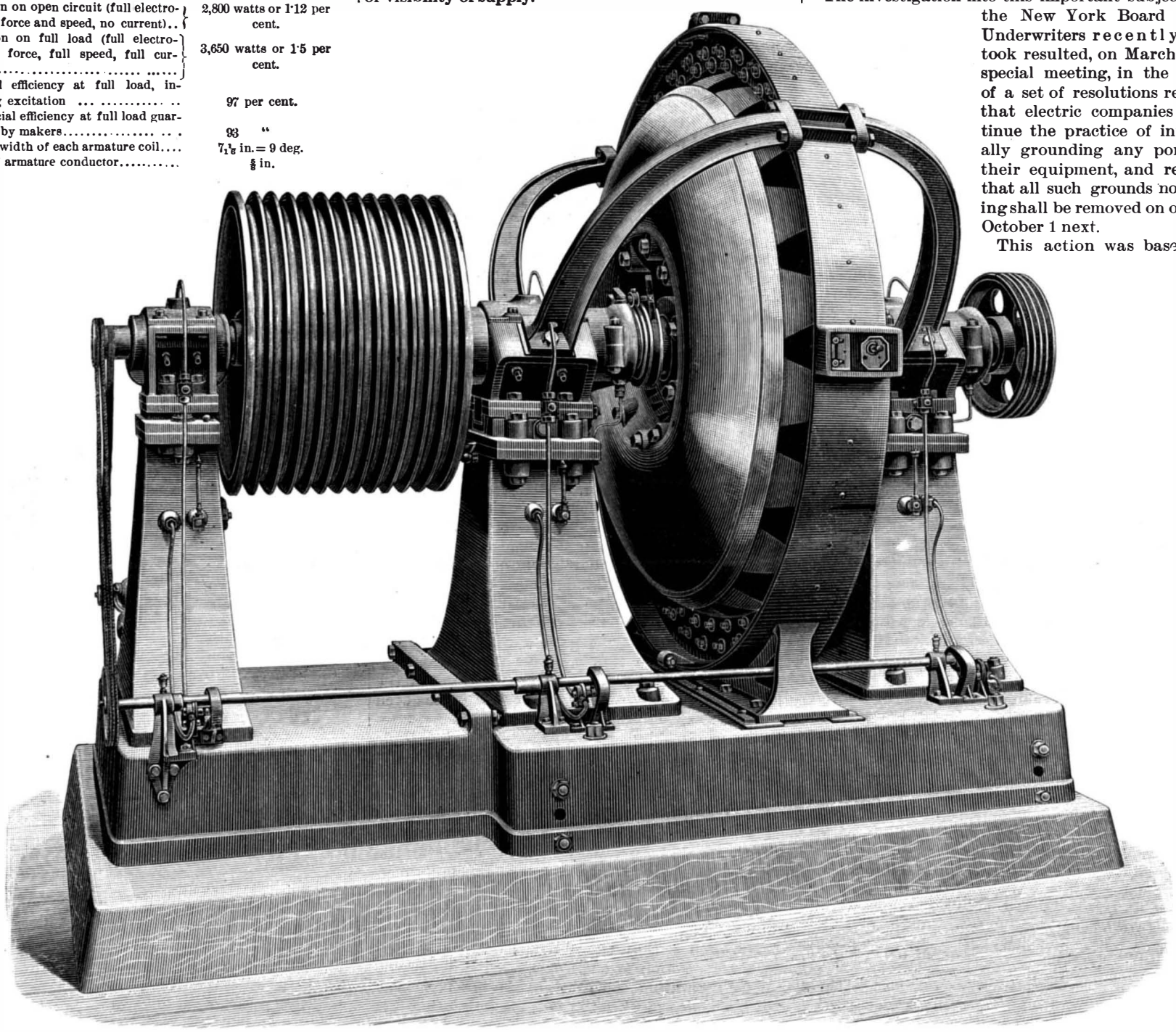
250-KILOWATT "MORDEY-VICTORIA" ALTERNATOR.

The Mordey-Victoria alternator was constructed by the Brush Electrical Engineering Company, Limited, of London and Loughborough, and is the size known as "A 20." This indicates that there are twenty polar projections on each side of the stationary armature of forty coils.

The following are the principal figures as to the size and performance of the machine:

Output	250 kilowatts = 335 E.H.P. at 2,000 volts.
Number of revolutions	300
Twenty polar projections, 40 armature coils	100 alternations per second.
Weight of revolving magnet and shaft complete	15 tons.
Weight of complete machine	20 "
Drop in volts between no load and full load	4½ per cent at constant excitation.
Rise in volts between full load and no load	5¼ per cent at constant excitation.
Increase of excitation (amperes) required to maintain constant electromotive force from 0 to full load	12 per cent.
Excitation on open circuit (full electromotive force and speed, no current)	2,800 watts or 1·12 per cent.
Excitation on full load (full electromotive force, full speed, full current)	3,650 watts or 1·5 per cent.
Electrical efficiency at full load, including excitation	97 per cent.
Commercial efficiency at full load guaranteed by makers	93 "
Greatest width of each armature coil	7 1/8 in. = 9 deg.
Width of armature conductor	§ in.



THE MORDEY-VICTORIA ALTERNATOR.

The armature is fixed, the supporting ring being divided vertically. The whole ring, or either half, may thus be withdrawn very rapidly. Such withdrawal is, however, not necessary either for examination, cleaning, or repairs, as, owing to the peculiar construction of the field magnet, any and every armature coil is fully accessible without the removal of any portion of the machine. Even when the machine is at work, owing to the persistence of vision effect the whole of the armature is perfectly visible, as each coil is alternately covered and uncovered by the revolving magnet horns.

The existing current is supplied to the single coil of the magnet by a pair of collector rings (one ring on each end or side of the magnet), two brushes being arranged on each ring.

From the data given above it will be seen that the excitation is very small, and that the amount of variation of the excitation required to maintain constant electromotive force is also small, while even if the excitation is maintained constant (that is if no regulation is attempted), the electromotive force of the alternator varies only about five per cent, even if the full load is thrown on or off. These satisfactory features are common to all the alternators of this type, but we are informed that in none to quite so high a degree as in the machine under notice.

The lubricating arrangements deserve attention. There are three solid white metal bearings. Efficient and abundant lubrication is secured by means of force pumps. Each bearing pedestal forms a large oil reservoir in connection with which is a small force pump, the three pumps being driven by a light steel shaft running the length of the bedplate, and belted to the magnet shaft. Oil is thus delivered under pressure to the bottom of each bearing. There is a by-pass tube with cock, supplying oil also to the top. After circulating through the bearing, the oil finds its way from each end by a separate visible outlet, and then is conducted to a small gauze filter, so returning visibly to the reservoirs, which contain such a large quantity of oil that renewal is only necessary at long intervals. The amount of oil passing to each part of the bearing is readily observed, and by using a visible open return, instead of a visible feed, the advantage of a supply under pressure is secured, together with the advantage of visibility of supply.

Further, each bearing is provided with a water-jacket space with connections for the attachment of pipes if necessary.

It will be noticed that the machine is made for 100 complete alternations, this being the standard rate adopted in all the apparatus of the Mordey-Victoria system. Great convenience results from strict adherence to this rate, not only on account of the parallel working of the alternators, but in connection with the design and construction of transformers, arc lamps, impedance coils, and other accessories. We are indebted to *Engineering* for our illustration and the foregoing particulars.

The Baltimore Railway Tunnels.

When the new Belt Line tunnel is completed, Baltimore will have about five miles of railroad tunnels under its streets. The Pennsylvania tunnel connects its Philadelphia and Northern Central divisions with its southern line, and the Belt Line tunnel will join the Baltimore & Ohio's Philadelphia line with its Washington branch. The Pennsylvania tunnel has always been a great inconvenience to travelers, because of the stifling smoke and coal gas. Plans, however, have just been completed to ventilate it by electricity, the same method to be employed by the Belt Line. Powerful dynamos will furnish the currents. The ventilation will be accomplished by building a slanting subway, eight feet wide by sixteen feet high, from the side of the tunnel near its top to the foot of the ventilating stack. At the foot of the stack a huge fan, fashioned like the blades of a steamboat propeller, will be revolved, creating a strong draught toward the top of the stack. The vacuum created at the middle of the tunnel will cause the smoke and gas to be drawn from the ends of the tunnel to its middle and out at the top of the stack. The stack is to be 100 feet high and 18 feet square.

Does Grounding the Neutral Wire Increase Fire Hazards?

There exists a difference of opinion among electricians as to the advisability of grounding electric light wires. One party contends that such practice increases the fire hazard, while the other argues from the opposite standpoint.

The investigation into this important subject which the New York Board of Fire Underwriters recently undertook resulted, on March 10, at a special meeting, in the offering of a set of resolutions requiring that electric companies discontinue the practice of intentionally grounding any portion of their equipment, and requiring that all such grounds now existing shall be removed on or before October 1 next.

This action was based upon the report of Prof. Henry Morton, in answer to questions propounded by the Committee on Police and Origin of Fires, with reference to fire hazards from the grounding of electric wires, and particularly the middle or "neutral" wire in the Edison system.

Prof. Morton is emphatic in his utterances, and states that in his opinion grounding the middle wire decidedly increases the fire risk. On the other hand, the Edison Electric Illuminating Company, replying to Prof. Morton's report, states that "It is the general opinion of the Edison interest that while absolute insulation, if it can be had, is preferable [to the grounding of the neutral wire], the advantages of grounding the neutral wire under certain conditions, and particularly on large systems, are such as to make that practice in those cases the best working method, particularly as a precaution against fire risk."

According to the *Electrical Age*, the resolutions will be considered and acted upon at the next meeting of the board, and the result will be awaited with interest, as the interests involved are large and important.

THERE is much truth in the remark of one who observed "The worst thing about the grip is that you are sick with it so long after you get well."

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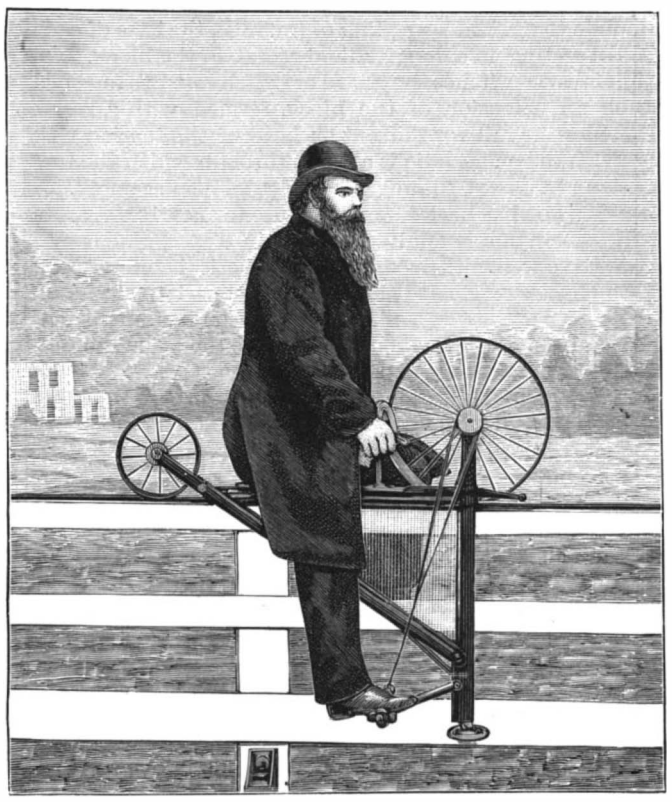
Epidemics—Influenza Due to Dust.

At a recent meeting of the Royal Meteorological Society, a paper on the untenability of an atmospheric hypothesis of epidemics was read by the Hon. Rollo Russell. The author is of opinion that no kind of epidemic or plague is conveyed by the general atmosphere, but that all epidemics are caused by human conditions and communications capable of control. In this paper he investigates the manner of the propagation of influenza, and gives the dates of the outbreaks in 1890 at a large number of islands and other places in various parts of the world. Mr. Russell says that there is no definite or known atmospheric quality or movement on which the hypothesis of atmospheric conveyance can rest, and when closely approached it is found to be no more available than a phantom. Neither upper nor lower currents have ever taken a year to cross Europe from east to west, or adjusted their progress to the varying rate of human intercourse. Like other maladies of high infective capacity, influenza has spread most easily, other things being equal, in cold calm weather, when ventilation in houses and railway cars is at a minimum, and when, perhaps, the breathing organs are most open to attack. But large and rapid communications seem to be of much more importance than mere climatic conditions. Across frozen and snow covered countries and tropical regions it is conveyed at a speed corresponding, not with the movements of the atmosphere, but with the movements of population and merchandise. Its indifference to soil and air, apart from human habits depending on these, seems to eliminate all considerations of outside natural surroundings, and to leave only personal infectiveness, with all which this implies of subtile transmission, to account for this propagation.—The origin of influenza epidemics was discussed by Mr. H. Harries. The author has made an investigation into the facts connected with the great eruption of Krakatoa in 1883, and the atmospheric phenomena which were the direct outcome of that catastrophe. He has come to the conclusion that the dust derived from the interior of the earth may be considered the principal factor concerned in the propagation of the recent influenza epidemics, and that, as this volcanic dust invaded the lower levels of the atmosphere, so a peculiar form of sickness assailed man and beast.

A RAIL FENCE BICYCLE RAILWAY.

A system of passenger travel is about to be put in operation between Mt. Holly and Smithville, N. J., by a company which has been organized to construct what is known as the Hotchkiss Bicycle Railway system. Each passenger furnishes his own motive power. The illustration will give, without any further detail, a good idea of the construction. The track rests upon a foundation of cross ties 3 × 6 in. by 3½ ft., which are placed at intervals of every 6 ft., and upon them rest wooden posts ordinarily 3½ ft. high. These are secured to the ties by bolts and angle irons. Narrow wooden stringers connect the posts, and the top stringer has a T-shaped rail fastened to it on which the bicycle runs. A special form of bicycle is required, although the ordinary saddle, handle bar and propelling mechanism are nothing new. The handle is not required for steering purposes, but is used simply as a means of convenience for the rider when in motion. The frame is double, extending down below the track rail on either side, a distance of 2½ ft., and has at the lower end a small guide wheel running horizontally, which serves to keep the machine in upright position, and absolutely prevents any possibility of jumping the track. The front wheel is the driving wheel, and is 20 in. in diameter, and like the other riding wheel is grooved to fit the rail. Two tracks will be constructed, so that the road may be operated in both directions at the same time. Side tracks will be placed at suitable intervals, at which the bicycles will be stored when not in use and at which point passengers can be supplied, leaving the machines at any station where they would wish to disembark.—*Street Railway Review.*



THE RAIL FENCE BICYCLE RAILWAY.

Overhead Rights.

Although any one may extend an overhead wire across or along a street, it does not seem generally known that no wire may pass over a house without the permission of the proprietor, even though the wire be in no way connected with the house. The owner may, if he pleases, take them all down, for his freehold extends from the center of the earth up to the sky. This is a principle that is not generally understood, but occasionally a householder is found who knows his rights and will not allow them to be infringed. Such a person was the landlord of a large boarding house on Beacon Hill, who made the electric light company provide bulbs for the lighting of his dining room in return for the privilege of stringing wires upon his roof. Few persons are so well posted in the law as to know what their rights are, and it is an object with large corporations to keep them in ignorance.—*Boston Courier.*

THE GREAT SUN SPOT OF FEBRUARY, 1892.

I have thought it would interest the readers of the SCIENTIFIC AMERICAN to have some photographic views of the great sun spot of February, 1892, good descriptions of which have already appeared. Quite a complete photographic record has been secured at this observatory of this great group of spots, from the time that it fairly rounded the sun's eastern limb, on February 5, to just before its disappearance, the last plates being taken on the morning of February 16. The photographs were made with an apparatus (constructed by the writer) attached to the 10 inch equatorial telescope. First, a view of the entire sun's disk is taken, four and one-half inches in diameter. These plates show the exact place of all spots upon the visible hemisphere. Then, usually, an enlarged view is taken, showing the more interesting spots in detail. The enlarged detail view is taken direct in the telescope, not copied from the smaller negative. It shows the group as it appeared on Feb. 16, as it was nearing the southwestern limb of the sun. The changes which have occurred in this interval will repay careful study. The rounded and darkened edge of the sun is well brought out. The lighter patches in the shading are immense fields of faculæ. The extreme length of this great group was about 150,000 miles and its width 85,000 miles.

THE GREAT SUN SPOT OF FEBRUARY, 1892.

WILLIAM R. BROOKS.

Smith Observatory, Geneva, N. Y., March, 1892.

ACCORDING to one of the French papers, electricity is in successful use at the gun factory at St. Etienne for tempering gun springs. The latter consist of steel wire which is wound spirally, and a current of 45 volts and 23 amperes is passed through it. Rapid heating results, and when the required temperature has been reached, the current is interrupted, and the spring is let fall into a trough of water. One workman can temper 2,400 springs per day by this method.

A Railroad from Cartagena to the Magdalena.

The construction of the Cartagena-Magdalena Railway deserves to rank among the most important rail road enterprises undertaken within the past decade in South America, by reason of the far-reaching results which will follow upon its completion. Its object is to connect the port of Cartagena with the Rio Magdalena by a line 52 miles in length, but to appreciate its importance the conditions affecting Colombian traffic must be reviewed.

The great centers of population in Colombia lie in the interior, with no outlet to the sea except by way of the Rio Magdalena. This remarkable river, flowing down from the mountains of Tolima, is navigable for vessels of 3½ feet draught, between 600 and 700 miles, into the very heart of the republic, and constitutes the artery of commerce between the outer world and the coffee and mining districts of Santander, Antioquia, Tolima, and Cundinamarca. Connection between the centers of production and the river ports is maintained by mule trains across the mountains, and yet in spite of these obstructions to free intercourse, the export and import traffic using the river amounts to 50,000 tons per annum. A further impediment to traffic is met at the mouth of the river, where the stream empties into the Caribbean Sea through a delta, whose several channels are obstructed by shifting sandbars, effectually precluding the entrance of ships.

Many years ago John C. Trautwine was employed by the Colombian government to attempt to control one of these channels, and other engineers have subsequently been engaged upon this problem, but all with negative results. In consequence of this the Bolivar Railroad was constructed from Barranquilla, on the Magdalena, to Salgar, an open roadstead on the Caribbean. More recently, a pier is being built at Puerto Colombia, about 2½ miles southwest of Salgar, and the railroad has been extended to that point. This, however, is also an open roadstead, and is a perilous point for ships during the prevalence of the "nor'westers" which frequently rage along this coast.

Cartagena, on the other hand, possesses a magnificent land-locked harbor, and in the colonial days was the port not only of Colombia, but of the entire western coast of South America as far as the northern confines of Chile. The products of the mines of Peru, of Ecuador, and of Colombia, came over the great mule road by way of Jaen, Cuenca, Quito, Popayan, and Quibdo, to Cartagena, whence they were shipped to Spain. By connecting a few creeks, lagoons, and bayous, the famous Canal del Dique was also constructed from Cartagena to the village of Calamar, on the Rio Magdalena, a shallow waterway which is still open for a few months of each year and diverts a small portion of the Magdalena traffic to this ancient port. It has long been foreseen that the advantages of the splendid harbor at Cartagena would inevitably restore this city to its former position as the port of Colombia, if it were connected with the Magdalena by a railroad. This is now to be done by a company of American capitalists who embarked in it at the instance of Mr. S. B. McConnico, formerly of the Illinois Central Railroad, who conceived the project, obtained concessions from the government, and had the preliminary surveys and estimates made which demonstrated its feasibility.

Two corporations have been formed to carry this work into effect, the Cartagena Terminal & Improvement Company, Limited, capitalized at $1,200,000, with J. Murray Forbes, president; S. B. McConnico, vice-president and general manager; Thomas R. Wheelock, secretary and treasurer; and W. D. Buckner, M. Am. Soc. C.E., chief engineer and superintendent; and the Cartagena-Magdalena Railway Company, capitalized at $1,800,000, and issuing six per cent mortgage bonds to an equal amount, with Thomas R. Wheelock, president; S. B. McConnico, vice-president and general manager; F. B. Beaumont, secretary and treasurer; and W. D. Buckner, chief engineer and superintendent. The full amount of capital needed to complete the road has been provided. Construction has already commenced, ten miles having been graded up to date.—*Railroad Gazette.*

Over Ninety-one Miles Per Hour.

Engine No. 385 of the Central Railroad of New Jersey broke all records of high speed on February 26, by running a mile in 39¼ seconds, or at the rate of 91·7 miles per hour. The engine is a Baldwin compound. In speeding this engine the first mile was made in 76 seconds, the second in 62, the third in 53½, the fourth in 45½, and the fifth in 39¼ seconds. The engineer reports that the engine was running fastest on the sixth mile, but it was not recorded on account of excitement which followed when the engine made this wonderful speed. Mr. Hoffecker, superintendent of motive power, informs the *National Car Builder* that he has every reason to believe the report correct, and that he has timed this engine himself while running a mile in 42 seconds. Four duplicates of this engine have been ordered.

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The Race Across the Atlantic.

In a recent number of the *Scottish Review*, Professor Henry Dyer gave an interesting article on the race across the Atlantic, in which, says *Industries*, he traces the development of steamships and their machinery, and gives figures to show the increase in speed and efficiency. After a preliminary notice of some of the earlier attempts at steam navigation, Professor Dyer devotes a little space to clearing the reputation of Dr. Lardner of some of the charges which are sometimes brought against him in connection with ocean navigation by steamships, and he expresses the opinion that, while Dr. Lardner may have erred in the way of overcaution, and have failed to estimate the possibilities both of engines and ships, as he based his calculations on a coal consumption of 12 pounds per indicated horse power per hour, with a speed of 8 knots, he does not deserve to be held up to ridicule, as he generally is when his name is mentioned in connection with the early attempts at transatlantic navigation.

The development of the marine engine forms an interesting study, both from a theoretical and a practical point of view. The effects of the increase of the pressure of the steam, the action of the steam jacket and of multiple cylinders, and the present position of practice are all traced by Professor Dyer, and they, combined, show the great improvements which have taken place. These are roughly indicated by the amount of coal consumed per indicated horse power per hour. Until about 1830 the boiler pressure seldom exceeded 3 pounds on the square inch above that of the atmosphere. From that date a gradual increase took place, and in 1845 the average was about 10 pounds per square inch. By 1850 it had reached 15 pounds. In 1856, Randolph, Elder & Co. employed pressures of 30 pounds in their compound engines, but it was not till almost ten years later that such pressures became general in the merchant service. On the compound engine becoming common, pressures suddenly rose to 60 pounds, and in some cases to 80 pounds and 100 pounds per square inch, and now for triple-expansion engines the average is over 150 pounds, while for quadruple-expansion engines it is 200 pounds per square inch. With regard to coal consumption, the earliest marine engines must have used very nearly 10 pounds per indicated horse power per hour. In the well known side lever engines it was about 7 pounds, while for engines in use before the general introduction of the compound type 4 pounds to 4½ pounds was the average. Randolph, Elder & Co., with their compound engines, had an average of from 2½ pounds to 3 pounds. In 1872, when the compound engine had been in use for some years, the average was found to be 2·11 pounds, being a saving of nearly 50 per cent over the ordinary engines, while in 1881 there was a reduction to 1·828 pounds, or a further saving of 13·37 per cent. With triple and quadruple expansion engines there has been a still further reduction of about 25 per cent, the consumption in some of those engines being as low as 1½ pounds or 1¼ pounds per indicated horse per hour.

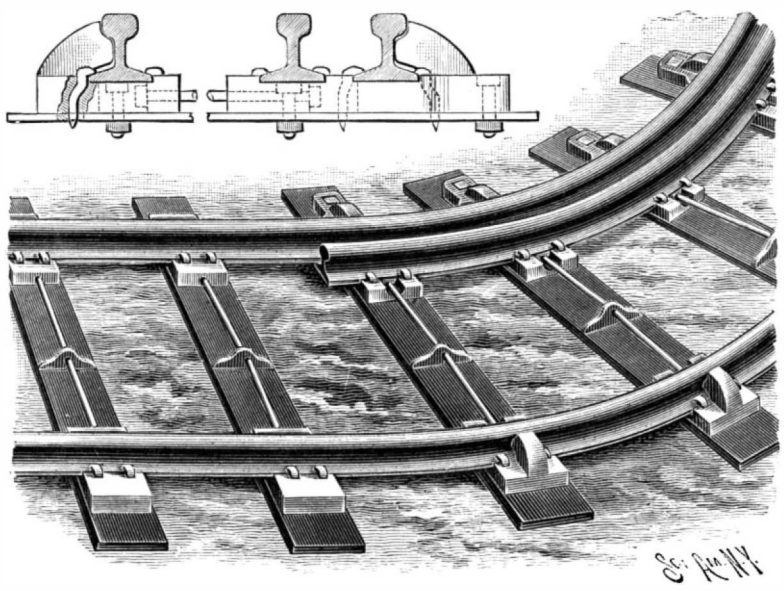
Professor Dyer traces the development of the size of steamships from the Great Western up to the present date. He gives figures to show the best runs during that period, and these are brought down to the recent ones of the Teutonic and Majestic. The latest development of the Atlantic race shows a close approximation between the best steamers of the White Star, the Inman, and the Cunard lines, there being only a difference of a few hours in favor of the order in which their names are given, the fastest passages of each varying from 5 days 16 hours 31 minutes to 6 days 2 hours 31 minutes. The Cunard line is thus temporarily a little behind in the race, but a company which has shown such spirit in the past is not likely to give up the contest. Two new steamers, each 600 feet in length, have been ordered, and it is stated that their guaranteed speed is to be 22 knots on the measured mile and 21 knots at sea. This latter speed will enable the passage across the Atlantic to be accomplished in about 5 days 10 hours.

Professor Dyer is of opinion that, as progress has been made by slow and steady steps, this is likely to continue unless we have a complete change in the type of ships, of engines, and of boilers. So far as can be seen at present, the shape of steam vessels is not likely to be materially altered, as it is substantially the same as that of the Viking's craft of more than a thousand years ago, and seems to conform to the arrangements of nature, with regard to fishes, as nearly as the materials at our disposal will admit. It must be remembered that increased speed is not simply a question of more power relatively to displacement, but that each shape of vessel has a speed to which it is specially adapted, and that any attempt to drive it beyond that speed would lead to a great expenditure of power with little useful result, as the energy would be chiefly expended in raising waves. If anything like the present speeds had been attempted with vessels of the size which were common on the Atlantic thirty or forty years ago, the size of engines required, and the extra expenses involved, would have reduced the earning power of the ships very much, and possibly in many cases made it disappear.

The future development of steamships, however, depends on conditions about which it is impossible to say anything very definite. The materials of construction have been changed from wood to iron, and from that again to steel. The engines have developed from inverted Watt engines, through a great variety of forms, to multiple-expansion engines of great complexity and considerable efficiency. All these may be rendered useless by some other form of heat engine or by the application of electricity. It is evident, therefore, that the limits of the sizes and speeds of steamships in the future are to be determined by commercial considerations and experience, rather than by abstract scientific speculations.

A PRACTICAL METALLIC RAILROAD TIE.

The improved metallic tie shown in the illustration has been patented by Mr. Ellison Saunders, of Austin, Texas. The base of the tie has outwardly and downwardly turned ends, preventing endwise movement, and rail-supporting blocks of cast or malleable iron are secured to the base by rivets or bolts, as shown in the sectional view. The rails are secured in their seats in the blocks by spikes, the apertures for which are preferably cast with a bend and twist, so that the upper half is out of alignment with the lower half of the aperture, the spike when driven then following the shape of the aperture, by which it is bent and twisted in for its lower half, so that it will not get loose. The two rail-supporting blocks of each tie are connected with each other by a tension rod, by adjusting the nut on which any desired strain may be given to the blocks and base plate to prevent spreading of the rails, the base of each rail resting in a longitudinal recess in the block. On curves or switches the guard or switch rails are fastened on an extension of the block, formed with a recess under the rail for the nut or head of the tension rod. Centrally on each tie is a block through which the tension rod passes, to prevent accidental displacement.



SAUNDERS' IMPROVED METALLIC RAILROAD TIE.

This tie has been in practical use for nearly a year on a portion of a trunk line railway in Texas, and is said to have well withstood the atmospherical changes and the heavy traffic, it being officially stated that "at no time since they were placed in position has any attention been given to them, while on either side the oak ties have needed attention at different times." At the Grand Central Station, New York City, these ties have been in use for the past nine months at a point where some of the largest engines pass over them each day, with many switching engines and cars, and the supervisor of the yard, Mr. Robert White, writes that "they have had no attention paid to them since being put in, and still remain in perfect order. The spikes have not started, but are the same as when put in."

Method of Producing Photo-mechanical Printing Plates.

BY LUDWIG SCHAEFER, OF HEILBRONN, GERMANY.

Upon exposed and developed sensitive gelatine paper I cast a layer of plaster of Paris whose tendency for hardening has been retarded to a certain extent by the addition of marble dust, glue, borax, or the like. As soon as the plaster cast has the necessary degree of compactness the gelatinized paper is removed or pulled off, and in place of the same is laid a glass plate. The plaster cast is allowed to rest on the glass plate, so that the weight of the cast will cause the elevations to be forced back into the mass until every delineation comprising the drawing or representation lies upon one and the same level. The depressions or indentations between the delineations of course lie on a lower level than the delineations; but said delineations occupy a common level, so as to be suitable for printing. From the plane and level plaster cast thus obtained casts in wax, metals, plaster of Paris, or the like can be made, or after the hardening of the original plaster cast I can press into the same any mass that is capable of being shaped or formed.

Somnal.

In a recent article in the *Medical Record* by O. M. Myers, M.D., of Rochester, N. Y., he says:

Much interest has centered upon the new hypnotic, somnal, and clinical reports of its use, together with experimental data, are rapidly confirming, and even exceeding, the claims of its discoverer. The medical fraternity will gladly welcome this new-comer to its materia medica, as it seems to possess the properties of a hypnotic *par excellence*, without the distressing and dangerous qualities of other drugs of this class. All of these latter are notoriously uncertain and inconstant in action, and most of them, especially chloral and morphia, expose the patient to the dangers of habitual use. The administration of somnal is happily free from these unpleasant sequelæ. Since the time of its discovery by Radlauer, of Berlin, in the fall of 1889, the action of somnal has been rigidly scrutinized and impartially investigated, which has resulted in unqualified indorsement of its efficiency and reliability; and its prompt and harmless qualities have been the delight of all clinical observers.

Summary.—1. Locally, somnal is non-irritant, exerting rather a stimulating effect upon the mucous membrane of the stomach. When applied directly to the heart of the frog, it acts as a powerful poison, destroying its electro-excitability.

2. In therapeutic doses the drug exerts no appreciable physiological effect upon the heart, and may be regarded as safe. Toxic doses depress that viscus: *a*, by direct action upon the muscle fiber; *b*, by stimulation of the cardio-inhibitory centers.

3. Therapeutic doses have little or no effect upon the pulse rate. A slight primary rise in the arterial tension may be observed, which soon returns to normal, or may even fall below—the latter probably due to muscular relaxation during sleep. Toxic doses rapidly diminish pulse rate and pressure; probably due to direct action upon ganglionic heart centers.

4. Ordinary doses cause the respiration to become slow and full. Toxic amounts induce rapid, shallow, and irregular respiration; the result of depression of the respiratory center at base of brain.

5. As, in therapeutic doses, sleep is induced without perceptibly affecting any other portion of the economy, it is fair to conclude that somnal acts directly and primarily upon the cerebrum.

Therapeutics.—The indication most promptly and perfectly met by somnal is to induce sleep, and it may be confidently relied upon by the prescriber in all cases where the insomnia is not the result of pain or syphilitic disease. As the nervous element predominates, somnal is the more certain to fulfill the requirements; as, for example, insomnia due to functional over-excitement of the brain after mental strain or anxiety, sleeplessness of delirium tremens, and in maniacal and hysterical disturbances. Its sedative and somniferent action is strikingly efficacious in the insomnia occurring during convalescence from acute disease. Where an adynamic condition exists it must, of course, be used with caution. In whooping cough, spasmodic laryngitis, asthma, "nervous cough," and chorea, it possesses decided sedative properties. A great element of safety is that the action of somnal, so far as I have observed, is never out of proportion to the amount ingested, nor does it act in a cumulative or other unexpected manner. The drug appears to possess little or no influence over insomnia due to acute inflammatory conditions.

A Simple Relief for Lung Troubles.

It has long been known that pine needle pillows would alleviate persons afflicted with lung troubles, and a Florida editor relates an incident in support of the fact as follows: During a visit to the home of a most estimable lady living on Indian River, this editor was told of a discovery that had been made which may prove a boon to sufferers from lung or bronchial troubles. This lady having heard that there was peculiar virtue in a pillow made from pine straw, and having none of that material at hand, made one from fine soft pine shavings, and had the pleasure of noting immediate benefit. Soon all the members of the household had pine shavings pillows, and it was noticed that all coughs, asthmatic or bronchial troubles abated at once after sleeping a few nights on these pillows. An invalid suffering with lung trouble derived much benefit from sleeping upon a mattress made from pine shavings. The material is cheap, and the *Christian at Work* says it makes a very pleasant and comfortable mattress, the odor of the pine permeating the entire room and absorbing or dispelling all unpleasant odors.

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RECENTLY PATENTED INVENTIONS.

Engineering.

SMOKE CONSUMER. — Edson J. Hadlock, Big Spring, Texas. This smoke consumer is especially applicable for use on locomotives, causing the smoke to be returned from the stack to the fire box, also condensing the exhaust steam and heating the water in the tender. The locomotive smoke stack is curved, and a curved receiver is arranged to receive the smoke from the stack, while pipes lead from the receiver through the water tank of the tender and into the ash pit of the locomotive.

STEAM PUMP.—Daniel F. Lepley, Connellsville, Pa. In this pump the main slide valve is connected with a valve stem forming the rod for a piston of an auxiliary engine adapted to actuate the valve. The piston of the auxiliary engine slides in a cylinder supported from the steam chest, and in the inlet ports of the auxiliary engine are stop cocks, each having a valve stem extending to the outside of the cylinder, whereby more or less live steam may be passed to the cylinder of the auxiliary engine, so that the slide valve is actuated with greater or less velocity, regulating the speed of the entire pump. The construction is simple and durable, not liable to get out of order or become clogged, and the arrangement is designed to prevent undue jarring when the pistons reverse.

CONDENSING FLUE DUST.—Hiram W. Hixon, El Paso, Texas. This invention provides means for condensing and saving the flue dust passing with the waste gases through the chimneys of lead-smelting furnaces, such dust ordinarily carrying a quantity of silver and lead which would otherwise be lost. A closed vessel is connected with the flue of the furnace, and a series of pipes in its bottom extend into a water tank below the water line, above which an exhaust fan forms a partial vacuum, so that the gases from the furnace are passed through the water, and the flue dust is separated and condensed in the tank.

Railway Appliances.

GUARD RAILS.—Hiram H. Sponenburg, Mikado, Mich. This invention provides means for clamping the guard rails to the main line rails, whereby spikes are dispensed with and the length of the rails reduced to five or six feet, perfect security against accident being at the same time obtained. A bar clamp embraces the outer flange of one rail, and a block clamp embraces the opposite rail flange, with means for securing one end of the bar clamp, to which an intermediate rail clamp is adapted for attachment. In practice two sets of clamping devices will be used for each guard rail, one located nearly opposite the point of the frog and the other nearly opposite the knee of the wing rail on the frog.

STATION INDICATOR. — William S. Mallard, Darien, Ga. This invention provides a novel construction and combination of parts whereby separate sign cards or slides bearing the names of different stations may be successively shifted from one compartment to another of a dual casing and then returned to the compartment from which they were taken in a reverse order of succession. The mechanism by which the transposition is effected is automatic in its action, the passage of the final card in either direction reversing the transposing devices, and the indicator is designed to be less expensive and easier to manipulate than previous devices of this character.

Mechanical Appliances.

WATER WHEEL. — Joseph H. Choate, Jr., Stockbridge, Mass. An inner wheel with curved buckets is contained within an outer wheel having straight vanes discharging into the buckets of the inner wheel, and standing tangential to a circle of less diameter, the shaft carrying the inner wheel turning in the hollow trunnions of the outer wheels. A gear wheel is held on the shaft, in mesh with which is an intermediate gear wheel, while a main driving shaft carries two gear wheels, of which one is in mesh with the intermediate gear wheel and the other with a gear wheel on one of the trunnions of the outer wheel. The construction is designed to be very effective, utilizing the head of water to the fullest advantage.

CLUTCH.—Samuel B. Williams, Martin's Ferry, Ohio. This is an improved friction clutch to be used upon pulleys and drive wheels to throw them in and out of gear, or it may be employed as a cut-off coupling to throw a portion of a shaft in or out of motion. Combined with a central moving disk is a friction disk sliding upon a feather, slotted guide plates being attached to the periphery of the friction disk, while levers are pivoted to lugs attached to an abutting disk, link rods being connected with the levers and a sliding collar connected with the link rods.

SAWMILL CARRIAGE INDICATOR. — Isaac Burlingame, Fremont, Washington. This is a device adapted to be secured to the set shaft of the sawmill carriage to clearly indicate the position of the knees of the carriage, and magnify any change in their position, so that the change will be readily discernible to the setter and to the sawyer. It consists of a cylinder to be secured to the set shaft and provided with parallel rows of indicating numbers upon its face, a block having pointers at each end being held to move longitudinally upon the face of the cylinder.

TUBULAR WELL TOOL. — William Richards, Mayburg, Penn. This invention relates to devices for raising casing tubes or rods in oil or artesian wells, providing therefor a tool which is simple and durable in construction, readily applied to the tube or rod, and arranged for convenient attachment to the hoisting machinery for lifting the tubes or rods out of the well. The invention covers novel parts and details, and special combinations.

WOOD CLAMP. — Edward L. Still, New York City. Combined with a bed having tail and head stocks, each provided with a vertical screw having a longitudinal slot and a nut, is a longitudinally-extending screw mounted on the bed with its inner end engaging the head stock to operate it, the invention also embracing various other novel features. The clamp is designed to be quickly adjusted to hold glued pieces of wood firmly together while the glue is setting, preventing them from warping while the pressure is applied to them, also providing means for attaching legs to the bed of the clamp, and thus making a horse of it.

CRIMPING MACHINE. — Richard Whitaker, New Brunswick, N. J. A gripper is held to slide in a tubular body having an open end with a tapering inner wall, the gripper being provided with a series of parallel spring fingers having thickened tapering outer ends and transverse grooves adjacent to these ends, a revoluble screw being journaled in one end of the body and fitting a threaded bore in the inner end of the gripper. The device is designed for crimping or fastening metallic caps upon nozzles, and is especially adapted for fastening caps upon the nozzles of varnish cans, being rapidly operated therefor and doing the work well.

NAIL PULLER. — Melville Loftin, Hildreth, Ill. Pivoted on the sides of a handled claw hammer is an arm extending in opposite directions from its fulcrum, the arm being forked at one end and having a point formed on its other single end. The device constitutes a tool of simple and durable construction for conveniently pulling nails, extracting staples, etc., and useful in removing wire from fences, and sealing strips from boxes, etc.

JOINT MOULD. — John C. Raymond, New Brunswick, N. J. This is a mould to facilitate the joining together of lead pipes, around which it may be quickly and nicely fitted to enable the molten metal to be cast around the joint, which will be quickly made and as nice as the "wiped" joint made by hand. The mould has been thoroughly tested by plumbers, and it is said a perfect joint can thus be made within three minutes, while the work requires no special skill, enabling every man to this extent to do his own plumbing. It is said a large plant is soon to be established for the manufacture of this mould and its adjuncts.

Agricultural.

PLANTER AND CULTIVATOR. — Henry M. Horne and Joseph W. Asbell, Annie, Ga. This is a combination machine of strong and simple construction, designed to be very effective in work. All the parts constituting the machine are bolted together, and the arrangement of the plows and manner of attaching them are such that the parts are readily detachable or can be adjusted for deep or shallow work in a few moments' time.

PEANUT PLANTER.—Finton F. Ferguson, Murfreesborough, N. C. This is a combined ridger, pulverizer, seed planter and fertilizer distributer, which is simple in construction, inexpensive to build, and designed to drop the peas without danger of crushing them. While the machine is especially adapted for peanut planting, by placing the ordinary cotton seed box in place of the pea box the machine will be in condition for planting cotton, or it can be readily adapted for planting corn and potatoes.

POISON DISTRIBUTER. — Charles H. Pickering, Houston, Texas. This is a device designed for attachment to a saddle, to be operated at either side of the animal by the rider, to distribute poison on cotton and other plants, to destroy insects and worms. The device has a bellows, a poison receptacle, and a spout through which the poison is blown; it can be quickly and conveniently attached to a saddle, and the driving shaft may be turned in either direction to operate the gearing of the forcing mechanism.

Miscellaneous.

HOISTING MACHINE.—John Cosgrove, Roanoke, Va. This invention relates more especially to hoisting machines used in the construction of buildings for elevating material to the workmen, providing therefor a machine that is simple, strong, inexpensive, and very practical. A mast is detachably connected to a main frame, so that it can be readily changed from one side of the frame to the other, to adapt the boom to work toward the scaffold on either side of the building, and the manner of bracing the frame is very effective when it is desired to lift very heavy material, additional weight being applied to the rear brace beams without applying any weight on the building proper.

INDICATOR LOCK. — Leonard T. Crabtree, Embarrass, Wis. This invention provides a new and improved recording door lock more especially adapted for use on railroad freight car doors and other doors, and arranged to automatically keep record of all opening and closing of the door, while the construction is designed to prevent the picking of the lock. The locking lever has an impression block over which passes a strip of paper, a key having a character marked at one end being adapted to press an inking ribbon on to the paper and press the latter on the impression block. The process of tracing off a sealed record, as now followed, will be avoided by means of this improvement, it being readily determined by the examining official by whom and between what stations the car door was last opened.

TRUNK. — Henry W. Rountree, Richmond, Va. This is an improvement upon a former patented invention of the same inventor, the trunk having at its ends tray-supporting strips inclined upward from front to rear and provided near their rear ends with rollers, the tray supported upon the strips being arranged to be moved when the cover is opened back partially, there being also a roller provided at the front lower corner of the tray. The tray is re-enforced by metal plates or bands to which the supports or brackets of the tray rollers are secured.

ICE VELOCIPEDE.—Isaac Dart, Swanzy, Mich. A frame is supported upon front and rear runners, and mounted in the frame between the runners is a wheel in the rim of which are spring-pressed spikes adapted to engage the track by the work of treadles on the shaft of the wheel. The seat is attached to the upper part of the frame, a steering rod extending to within convenient reach, and the velocipede is designed to facilitate rapid traveling over ice or hard snow tracks.

CURTAIN FIXTURE.—William Doulin, Wheeling, West Va. This invention provides an adjustable bracket having an outward projecting arm, with vertically projecting arms forming a curtain-rod-receiving slot, for supporting the roller in the desired position in relation to the sash and frame, and so that when the upper sash is raised or lowered the shade and curtain will be correspondingly moved. Means are also provided for bringing the edges of the shade and curtain beyond the sides of the window frame, so that the window will be as nicely shaded as when the common form of fixtures is used.

SLIDING BLIND ATTACHMENT. — William H. Boyle, Oswego, N. Y. This is a simple, inexpensive, and convenient device to keep the blind from rattling, and which will enable the blind to be held at any desired height. The frame or casing has the usual vertical grooves in which the blind runs, and in the edge of the blinds are recesses with shoulders engaging the hooked ends of spring arms secured to a sliding abutment, this abutment sliding in the back portion of the grooves, and moving vertically with the blind, the pressure of the spring arms causing the blind to be held tight enough so that it will not rattle.

TYPEWRITER ATTACHMENT. — George F. Loar, Gibson City, Ill. A simple mechanism for operating the machine to make the necessary line spaces is provided by this invention. The mechanism may be readily applied to any variety of typewriter and may be worked by the foot or knee of the operator. The carriage is connected by a bell crank lever with a treadle, by pressing upon which the carriage is moved to the right hand end of the machine, by which also the line space lever is brought against a cam-like frame, whereby the feed cylinder is rotated in the usual way.

BOOK. — John E. Spears, New York City. Combined with a copying or other book, and a creased or jointed flexible strip attached to its cover to fold upward, is an index proper secured to the upper side of the strip at a point a short distance from the crease, whereby in folding the index the strip bends upward and folds inward directly under the cover, the index proper being also folded down upon and not within the portion of the strip that lies outside the crease, so that when fully closed within the book the lettered edge of the index is visible.

HORSESHOE. — Charles E. Howard, Leighton, Iowa. A sharp toepiece or calk of novel shape and a special attachment of the same to the shoe is the distinctive feature of this invention, whereby a very light racing shoe is produced. A much lighter plate is used for the shoe than is practicable where the steel toepiece has to be welded or secured by screws on to the plate, and a shoe is obtained adapted to facilitate the horse's travel either on a hard, dry track or on a wet or muddy and frozen track, one giving a firm footing and preventing slipping.

BRAKE SHOE. — Mark A. Penney, Perris, Cal. This invention provides a brake shoe for road wagons, having a face which may be readily renewed. The brake shoe body is formed of a single casting, having on its inner face at opposite edges inwardly-projecting flanges, a stop ledge, and an external attaching flange, the upper end of the recess formed by the flanges being open to receive and permit the removal of wood brake blocks, which form the frictional face of the brake.

VEHICLE HEATER.—Andrew E. Jones, Richmond, Ind. This is an improvement in heater attachments which are suspended from the bottom of a vehicle, the foot board being provided with a heat-escape register of two elongated chambers, with parallel apertured walls, there being a casing below the apertures with a glazed opening, and a lamp hung within each casing. The light of the lamps also shines through the doors to illuminate the roadbed ahead of the team.

METALLIC SHINGLE. — Herman H. Bohen, Leavenworth, Kansas. A male lock is formed on one side of this shingle, with three flanges, and a female lock on the other side, with a hook-shaped interlocking flange adapted to be engaged by the flanges of the male lock of the next following flanges. The shingle is simple and durable in construction, can be easily applied by any one of ordinary skill, and forms a double lock to prevent rain driven by a storm from passing underneath, at the same time permitting free expansion and contraction.

GATE.—Hiram Barker, St. Joseph, Mo. This gate is so constructed that it will swing upward and backward upon a pivot in opening and upward and forward in closing, and it is provided with a movable weight, which, in conjunction with levers connected with the gate, will admit of its being opened or closed by a child. It is designed as a field or yard gate, and means are provided whereby it may be adjusted to clear it from snow and ice in the winter.

POCKETBOOK SUPPORT. — John G. Gareis, Brooklyn, N. Y. This is a device for attaching the pocketbook to the hand of the owner, to prevent it from being snatched or misplaced, at the same time permitting the book to be readily opened and closed, A ring to be worn on the finger is connected by a swivel with the back of the pocketbook, the swivel permitting the book to be turned in any direction. The swivel is formed with a pin passing through a metallic plate on the inside of the back of the pocketbook, and the ring is made adjustable and split to fit on differently sized fingers.

TROUSERS STRETCHER AND HANGER. —George E. Hamlin, New York City. A series of horizontal fork-like arms are pivoted in a body section, the members of the arms having more or less spring action, and having their outer extremities flared in opposite directions. The trousers are so suspended that their own weight while in suspension will effectually relieve them from wrinkles and bagginess at the knees, and a number of pairs may be hung up and stretched in a small space.

DRAWERS. — Emma Walker, Jersey City, N. J. This invention relates more particularly to men's drawers, of jean, flannel, or inelastic material, having a slit in the lower end of each leg, and provides means of snugly closing the slitted portion upon the leg. An elastic band is secured to the drawers leg beyond the slit, with fastening devices engaging the leg at opposite sides of the slit. The attachment is very simple, no stitching of any kind being absolutely necessary, and the elastic or band is readily renewed when required.

WASHING MACHINE. — William H. Hornby, Toronto, and Lucas M. Lent, Ridgetown, Canada. This invention relates to improvements in machines which have a concave rubber bed and a convex rubber rocking above the bed. The machine is simple, and its construction affords complete control of the rubber, to rock, elevate, depress, remove and replace it without disconnection of any attached parts. A convenient clothes receptacle or tray is also provided for receiving clothes passed through the wringer, the tray folding within the machine when not in service.

MOTOR FOR CHURNS.—Wilson Omer, Cainsville, Mo. The motive power of this device consists of a weight which by its descent actuates gearing, the weight descending along a spirally coiled wire rod forming its track around a vertical shaft, the rotation of the latter, through suitable gearing, rotating screw-twisted dasher blades. The weight is elevated by the use of handles or a crank lever, and the height of the standards and driving shaft are designed to be such that the time of descent of the weight will be sufficient to effect a churning without further aid of the operator.

BEVERAGE. — William M. Myers, Hannibal, Mo. This is a non-intoxicating effervescent beverage having medicinal qualities. It contains hops, starch, molasses, sarsaparilla, citrate of magnesia, turmeric, and other substances, compounded as described. The beverage has the appearance of ordinary beer, but is designed to be much more pleasant to the taste.

GAME APPARATUS.—Grant B. Nichols, Wapakoneta, Ohio. This invention provides a game to be styled "ringing the bells," there being arranged on a board or table a series of bells having peculiarly constructed handles, and a cue being employed to which a ring is attached by a line: the cue is to be manipulated in such a way as to whip the ring over the handle of a bell, and lift the bell from the table, ringing it at the same time.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention and date of this paper.

SCIENTIFIC AMERICAN

BUILDING EDITION.

APRIL NUMBER.—(No. 78.)

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2. Plate in colors of a residence at Bensonhurst, Long Island, N. Y. Perspective elevations and two floor plans, an excellent design.
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6. A mountain side residence erected for W. A. C. Chase, at Montclair, N. J. An excellent design. Floor plans and two perspective views, also an interior view. Cost $6,500 complete. Munn & Co., architects, New York.
7. An Asbury Park, N. J., cottage. Cost $3,000 complete. Floor plans and perspective view.
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9. View of the Richmond Hill Congregational church and parsonage.
10. Design for a family burial vault.
11. Design for organ, All Saints, Compton, Leek.
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(4221) A. H. asks: 1. Could I use a cup made out of tin plate for the Lalande-Chaperon battery described in SUPPLEMENT, No. 792, and in "Experimental Science," instead of cast iron? A. A cup of tin plate would not be very serviceable. Use cast iron or glass in preference. 2. What is the black oxide converted to by the action of the battery? Is it to pure copper? A. Pure copper. 3. Have a lot of copper scrap; how can I convert into black oxide? A. Heat to strong red heat in air and pound or shake off oxide as fast as it forms.

(4222) C. A. B. asks: 1. If the needle of an ordinary galvanometer is deflected say 30° by two different cells of battery, does it denote that they have the same voltage or amperage? A. It depends upon the character of your galvanometer. If its resistance is very high, it is practically a voltmeter, and shows that the voltage of the two batteries is the same; but if its resistance is very low it acts as an ammeter and indicates that the amperage of the two cells is practically the same. 2. If one cell deflects say 20° and the other 30°, what is the rule for estimating their comparative voltage or amperage? Is it as the square of these numbers? A. This depends so much upon the character and proportions of the galvanometer that it does not admit of a very direct reply. If your galvanometer acts as a tangent galvanometer, the current will be proportional to the tangents of the angle of deflection. 3. What is the voltage and amperage of the ordinary Grove battery (small size), and also of the gravity battery? A. The voltage of the Grove battery is about 1·9 or 2. As the resistance of the Grove cell is about one-half an ohm, the battery will yield a current of nearly 4 amperes. The resistance of the gravity battery averages about 3 ohms, and its electromotive force being about 1 volt, it would yield a current of ⅓ of an ampere. 4. In the construction of a storage battery, how large square should each of a pair of lead plates be in order to obtain one ampere hour? A. Plates 5½ by 12 have a voltaic capacity of 14 ampere hours per pair. 5. What size of iron wire and what length of same can be heated to redness by one ampere? Thus affording an approximate method of measurement. A. As wire of the same nominal size from different manufactories varies considerably, your proposed test would be of no value. 6. How many ampere hours and what would be the voltage of a storage battery of six cells connected in series each cells containing two lead plates 6 by 8 inches? A. The electromotive force would be about 12 volts. Its voltaic capcity would be 14 ampere hours per pair of plates.

(4223) G. E. T. writes: Outside of the question as to adaptability, what are a few of the occupations that are most promising to the rising generation of young men, businesses that are new, at least comparatively so, and, at the same time, sure, both as regards the financial and the physical and moral phases of the question? Could you direct me how to get a beginning in any such, and work up? Am a young married man, 25, a stenographer, graduate 1885 of high school in Ohio, with physics and chemistry favorite studies. Might it be possible for me to materially modify the confining, sedentary nature of my present work by combination with something requiring a good proportion of manual exertion? If this were possible, it seems to me it would considerably reduce the otherwise frequent tendency to nervous irritability. I am always an enthusiastic reader of SCIENTIFIC AMERICAN. Believing that your knowledge of some such embryo enterprises, to whom it might not be unprofitable for me to make application, and perhaps right here in my own city, is much more extensive than mine could possibly be, I take this liberty to intrude upon your valuable time. A. Among the thousand and one ways of livelihood in this age of progress and invention, we feel our incapacity to enumerate in detail the business ways to success for the energetic and persevering young man. Adaptability must not be left out of the question; if you do, you are sure to fail. Find what you would most like to do, and what you would feel contented with under any conditions, and do it with all your might. Do not forget that there is always room at the head of the class. There is no royal road to financial success in these times, although the lucky strings may still hang out. The new ways are devious and misty. Better follow the trodden paths of well known business ways than fall into the quagmire of adventure. Finally we advise the development of present employment to its best income, and take up a systematic study of any profession or business best suited to your taste and devote all your spare time in becoming familiar with all its aspects, when in the near future you may be able to make the change smoothly and without strain upon the necessities due to your social condition.

(4224) W. A.—A water glass such as you require is made by inserting a plain piece of glass in the lower end of a tube, and making the joint watertight, so that the tube can be forced down into the water, leaving the upper surface of the glass dry. The size of the glass is immaterial. The object of this arrangement is to secure a smooth plane surface and to prevent reflection from the surface of the water.

(4225) A. W. writes: 1. Referring to the simple motor described in SUPPLEMENT, No. 641, will a soft cast iron core for the armature do as well as the soft iron wire core? A. Cast iron does not answer well as an armature core. The core must be laminated to secure good results. 2. Will a soft cast iron field magnet do as well as the Russia iron magnet? A. A cast iron field magnet will answer very well. 3. Can the motor be run as a dynamo without altering? If not, what changes must be made? I have a small steam engine that I made, and has been pronounced to be a very good engine, by an expert machinist (cylinder 1½ inch by 3 inches), and I am very anxious to run the motor or dynamo with it. Will you please tell me whether it will work or not (that is the motor)? How many revolutions ought the dynamo to make? A. Yes, but the electromotive force would be quite low. If you desire a higher electromotive force, wind the machine with finer wire. Your engine will undoubtedly run the motor when used as a dynamo, but we advise you to construct a better machine after the directions given for making the Edison dynamo in SUPPLEMENT, No. 844.

(4226) H. P. H. asks: 1. Why is insu- lated iron wire not used on field magnets? A. Because of the disadvantages due to its resistance. 2. Can an induction coil be made to give 50 to 100 volts and 2 to 10 amperes from a battery current of 10 amperes 5 volts; 15 volts 5 amperes? A. No. 3. Would reversing the current in an induction coil without breaking the circuit be an improvement on the vibrator? A. An induction coil worked with an alternating current will give equal impulses in opposite directions, and has advantages over an induction coil worked by direct current interrupted by a vibrator. 4. Will a storage battery made of tin plates coated with red lead be practicable? A. We think the tin plate would be rapidly corroded. 5. What would be the effect of joining the terminals of a half inch spark induction coil to the primary of another half spark induction coil? If I connect the two secondary currents, what kind of current will it produce in the primary? A. You would secure a tertiary current in the secondary wire of your induction coil, but it would be far less than you could secure by using a primary coil having a sufficient number of turns to utilize the secondary current of the first coil. Your proposed induction coil we think is impracticable.

(4227) W. A. S. asks: What current is used on the ordinary incandescent circuit, also what voltage? A. The current used in an ordinary Edison lamp is a half ampere. The total current on the circuit would depend on the number of lamps. The E. M. F. is 110 volts. 2. Could a person standing on an insulating stool handle bare electric light wires on an arc circuit without danger? A. There is always danger in handling arc light wires under any circumstances. 3. Is a compound or shunt-wound dynamo best for arc lighting purposes? A. We believe series-wound dynamos are commonly used for arc lighting.

(4228) H. J. F. asks: 1. Will you please give me a receipt for making a dry battery for hydrogen and oxygen, and what kind of vessels to use? A. If you refer to a battery for decomposing water, we would say that any battery will do it, provided you use a sufficient number of cells. You will find a dry battery described in SUPPLEMENT, No. 794. 2. If I make simple electric motor twice the size, can I run a canoe 16 feet long, and how many miles an hour, and what part of a horse power would its strength be? A. A properly proportioned electric motor twice the size of the simple motor will run a boat of the size given. You can probably attain a speed of four miles per hour.

(4229) W. W. writes: Having seen in several articles (in some of our leading periodicals) on steam boiler explosions the frequent mention made of the proverbial saw mill engineer and his consequential explosions, and I being one of these unlucky waifs, would like to inquire how does he come to be a notorious outlaw? Is it through gross negligence on his part as a class, or is his boiler taxed harder than it should be, that is, why more saw mill boilers explode than any other class? A. As the explosions of saw mill boilers largely exceed in number those of the boilers of any other kind, and are from one-quarter to one-third of all the recorded explosions, there must be something in the management of saw mill machinery that perhaps engineers do not control. The overloading of boiler work and pressure beyond the safe condition of old boilers, by the instructions of parsimonious owners to inexperienced engineers, is probably at the bottom of the trouble. If a good engineer protests, the owner will find somebody to run his boiler, and the fraternity bears the ridicule.

(4230) E. J. K. asks: 1. Would two of the motors described in SUPPLEMENT, No. 641, run a row boat 12 or 14 feet long fitted with twin screws? A. Yes. 2. What is meant by the pitch of a propeller? A. It is the distance the screw would travel forward in one revolution if working in a rigid nut, or in other words, if one of the blades of the screw were widened so as to form one turn of a screw thread, the distance between the ends of the blade measured parallel to the shaft would be the pitch. 3. What pitch and diameter of propellers would be most suitable? A. The screw for such a motor should have a pitch of 8 inches and a diameter of 6 inches. 4. At what speed do you think they would drive it? A. Your boat would probably travel at the rate of about 3 or 4 miles an hour. 5. Can I increase the power of the motors by using more than 8 cells of battery to each motor? A. You would gain little by the use of more battery.

(4231) J. F. B. asks: 1. What is the re- sistance of an Edison 16 candle power lamp, and how much (length) No. 22 German silver wire will it take to equal it? A. About 115 ohms. It will require about 530 feet of No. 22 German silver wire to equal it in resistance. 2. In making a detector galvanometer for use on the Edison system, how much and what sort of wire should be used for the coil, wire to be wound on wooden ring with compass in center? A. Use enough No. 28 wire to secure its required sensitiveness and make the resistance of your galvanometer circuit equal to the resistance of an Edison lamp by the means of a rheostat. 3. What is the best way to remove oil from belts that are completely saturated with it? A. You can dissolve out the oil by using benzine or bisulphide of carbon. Both are highly inflammable.

(4232) M. S. S. asks: 1. What proportion of bichromate of sodium and water is used in the Fuller cell? A. Make a saturated solution of bichromate of sodium in water; to this slowly add one-fifth its weight of common sulphuric acid. 2. Does the zinc have to be of the shape shown in "Experimental Science," or could it be square? A. The conical form is generally preferred, but almost any shape will answer. 3. Of what material should the rod be which connects the zinc with the wire? A. Brass or copper. It should be well protected by means of gutta percha cement.

(4233) C. W. writes: 1. A says a one pint Bunsen will not run 10 hours on a motor. (Per answer SCIENTIFIC AMERICAN March 12, E. W.) B says it will. Which is right? A. It depends upon how the battery is used. On a short circuit it would probably run down in less than ten hours, but used on a circuit of proper resistance it will run 4 or 5 days, or a week, with one renewal of the electropoin fluid. 2. Will a 1-16 horse power motor run a coffee mill, common size? A. We think not. Considerable power is required for running even a small coffee mill. Probably a one-eighth horse power motor would not be too large.

(4234) H. P. A. asks: 1. Could the field magnet for the motor described in SUPPLEMENT, No. 641, be made of one piece of wrought iron, ends welded together? A. Yes. 2. Is there any dry battery that can be carried in the pocket powerful enough to light a one-half candle power light? A. Probably a Burnley or Gassner dry battery could be made small enough for this purpose. It would require 2 or 3 cells. 3. Could a tube of glass be used instead of one of hard rubber to go through the washers used in the dynamo described in SUPPLEMENT, No. 600? A. Glass could be used, but it is liable to be broken and might make trouble.

(4235) E. L. asks: 1. How many bat- teries 5 by 9 inches charged with diluted sulphuric acid will it take to furnish power for a two horse power motor? A. Plain sulphuric acid batteries are not adapted for running motors because they polarize readily and the power ceases. The best battery for power is probably the Bunsen cell. It will require 12 or 14 large cells per horse power. 2. Which is the best to charge a battery—copper sulphate or sulphuric acid? A. You will find the electric power from primary batteries very troublesome and expensive.

(4236) T. B. says: Please inform me how to ascertain the necessary horse power to run a boat of given dimensions? A. The power to run a boat depends upon required speed, form of boat and kind of wheel. The whole matter is discussed and tabulated in Haswell's Engineer's Pocket Book, pages 660, 661, 662. $4 mailed.

(4237) W. F. W. writes: Your explana- tion of the "juggler automaton," in a recent number of the SCIENTIFIC AMERICAN, leads me to ask for an explanation of the famous chess and checker automaton at the Eden Musee of New York. A. The chess playing automaton to which you refer is supposed to contain an expert player. It is believed that the mechanism shown to those who witness the game has nothing whatever to do with the playing.

(4238) E. P. V. R. asks: What is it that the photographers use to spot positive pictures? I mean the spots caused by dust on the paper. A. Most photographers touch up with India ink or sepia.

(4239) J. S. asks: 1. How can I make a small quantity, say a quart, of concentrated solution of sulphate of zinc, such as described for Trouve's blotting paper battery? (Niaudet, pg. 112.) A. You can procure the crystals of sulphate of zinc at any drug store. Dissolve as much as possible in warm water, allowing the solution to cool. Some of the zinc sulphate will crystallize out; the remaining solution is a saturated solution, which is what you require for a battery. 2. What is the difference between a polarized bell and an ordinary call bell? A. In a polarized bell, the armature which actuates the bell hammer is magnetized so that it will be acted upon by an alternating current. 3. "Experimental Science," page 421, states that it has been found uneconomical to use lamps of a lower voltage than 60; how can the eight-light dynamo in SUPPLEMENT, No. 600, be made suitable for that voltage? A. You can increase the voltage of the eight-light dynamo by increasing its speed. 4. Will tin plate (tinned sheet iron) do for washers in drum armatures? A. They will answer very well. They should be separated by paper as in the case of iron disks. 5. When resistance is introduced in a primary or secondary battery circuit, is the consumption of chemicals in battery retarded, or is the same quantity of current generated and partly wasted in resistance, and will a dynamo require less power to run it while the extra resistance remains in circuit? A. The consumption of chemicals in the battery is retarded by the resistance, and the output of the dynamo is reduced by the resistance, so that it requires less power to drive it.

(4240) G. L. G. writes: 1. I am making an induction coil as described in "Experimental Science." What size single-covered wire should I use for secondary coil? A. No. 36. 2. What difference would it make if I should use a soft iron rod instead of wires? A. A soft iron rod will not magnetize or demagnetize as rapidly as a bundle of wires; besides, eddy currents will form in the rod, which would interfere with the working coil. 3. In making the condenser would it do to put the foil on the paper while the paper is wet with shellac, as the foil condenser is easy to handle? A. Yes.

(4241) Steady Reader asks: 1. If I make the simple motor, described in Hopkins, twice the size, linear measurement, how much more power would I obtain? At what speed per hour would it drive a 12 foot boat, and how many volts and amperes would be required to run it properly? What diameter should the propeller be, and what should be the speed of the motor? A. About four times. You would probably not attain more than four miles per hour. The screw for the motor of the size described should be about 10 inches in diameter. The motor should make a speed of about 1800, and the screw 300 to 400 revolutions per minute. 2. Why is a bundle of iron wire preferable to solid rod in magnets, etc.? Give scientific reason. A. A magnet core of wires or of laminated iron is preferred to solid iron on account of the rapidity with which it can be magnetized and demagnetized, also on account of the absence of eddy currents in the cores. 3. Of what use is a telescope on galvanometers? A. A telescope serves to magnify the movement of the galvanometer needle and scale, and allows a more accurate reading.

(4242) C. S. H. says: Being about to take up some profession, and having no particular bent toward either mechanical or civil engineering, I write to you to ask you if you would kindly answer the following questions through your valuable columns, viz.: Which of the above professions is the most lucrative? In which is there the more opening? In both these questions I mean as a general thing, which is the best place to learn them? What college or shop? A. Both professions as stated are lucrative to those that succeed. Success is the reward of mastership in the business as well as the knowledge necessary to either profession. A college course is a necessity unless you have natural talent and push to master the details. If you have no practical experience, the shop is the place to begin, for the experience necessary to the profession of a mechanical engineer. A position with a surveying party as rod or chain man has been the starting point with some of our successful civil engineers.

(4243) P. C. S. asks: 1. In the 8 light dynamo, what material is the base between the base proper and bottom of field made of? A. Wood. 2. How are the fields held to bottom and apart? A. By bolts extending through the base board and through the wooden piece at the bottom of the field magnet. 3. What is the base proper (having binding posts) made of? A. Wood. 4. Would it make any difference if armature shaft was made ¾ inch with ⅝ trunnions? A. No. 5. Can the armature shaft-bearing yokes be made of brass instead of bronze? A. Yes. 6. Is the cross piece at top holding wire made of wood and just screwed to field magnets? A. It may be of wood; vulcanized fiber, however, is preferable. 7. Can you inform me of a book on gearing from which a person could learn to draught teeth? A. MacCord, Mechanical Drawing, price, paper $2.50, cloth $3.50.

(4244) J. R. asks how the ink is made and how it is used to protect the surface of glass from the white acid when used in etching floral and other designs such as are seen on table ware, etc.? Is there any book published on the subject? A. Beeswax is very generally used to protect glass in acid etching. Often the design is applied with diamond ink, a mix-

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ture of hydrofluoric acid and barium sulphate, no protector being used or needed. The "Scientific American Cyclopedia of Receipts, Notes and Queries," price $5, contains several receipts on the subject of your inquiry.

(4245) G. S. W. writes: In vol. x, No. 252, SCIENTIFIC AMERICAN SUPPLEMENT, "How to Make a Telescope," by Hopkins, it says the focusing tube, G, of brass is 1¼ inch internal diameter. Then, speaking of the astronomical eyepiece, the eye aperture should be 1¼ inch diameter, and the diaphragm about the same. As the diaphragm would be same diameter as the brass tube G, of what use is it? Is it not an error? Also what are the diameters of the lenses for the astronomical eye piece described, and what would be the combination for one of higher and one of lower power? A. In the article referred to, for "eye aperture 1¼ inches" read eye aperture ¼ inch. The rule for the combination of lenses for astronomical eye pieces is given in the article referred to. The focal lengths of the eye and field lenses should be as 1 to 3.

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Watch cases, ornamenting, C. Wilhelm 472,490
Water heater, H. B. Joyce 472,128
Water motor, running, J. E. Belt 472,467
Wave power motor, A. Rosenholz 472,398
Weighing and bagging machine, H. E. Hawk 472,455
Weir, automatic measuring, A. Johnson 472,127
Wells, apparatus for boring artesian, F. O. Brown 472,493
Wheel. See Buffing wheel. Car wheel.
Wheel locking device, electric, G. W. Blanchard 472,329
Whiffletree hook, T. Andress 472,491
Winding machines, traverse motion for bobbins in, J. A. Murphy 472,383
Window, O. Wagner 472,239
Winnowers, shaking sieve for, E. G. N. Salenius 472,275
Wire shelf bracket, H. L. Bradley 472,285
Wires, device for joining intersecting, G. M. & H. R. Lamb 472,059
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Woven fabric and weaving the same, G. H. Harvey 472,216
Wrapping machine, S. D. Tripp 472,202
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Bretzel, J. Pfenninger 21,450
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Measuring instruments, case for electrical, E. Weston 21,445, 21,446
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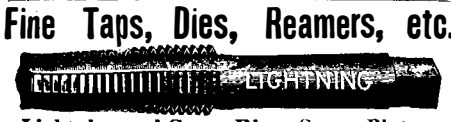

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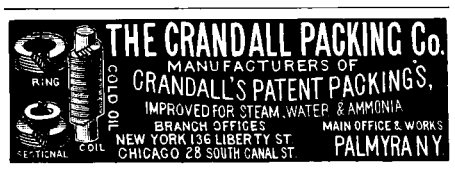

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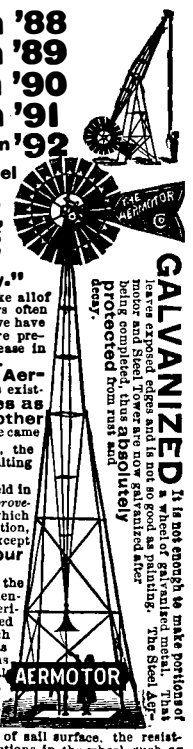

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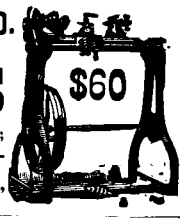

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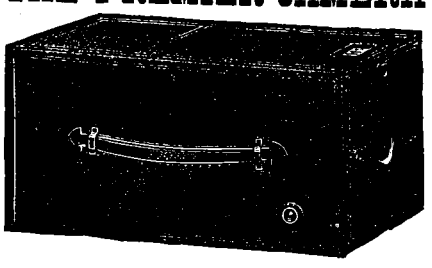

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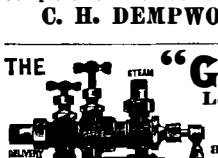

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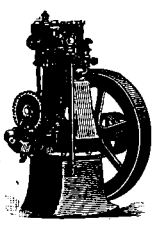

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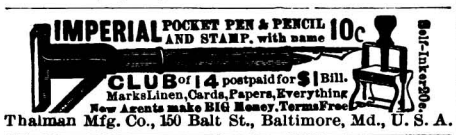
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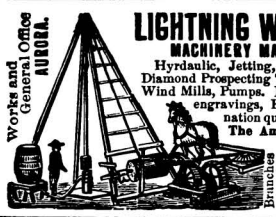

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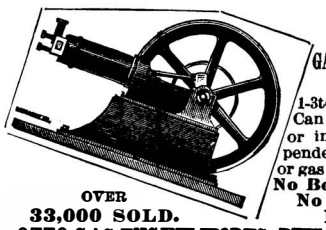

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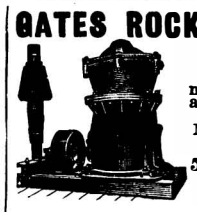

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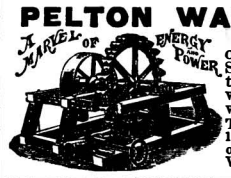

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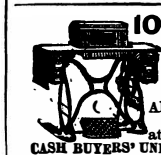

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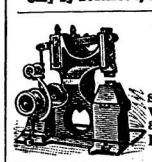

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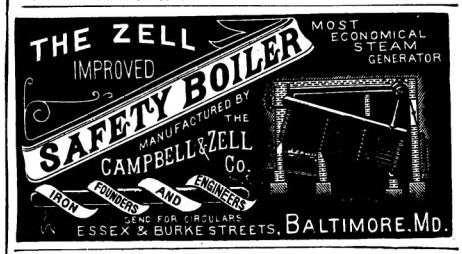

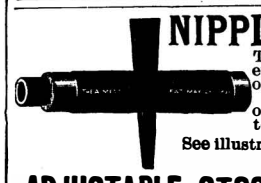

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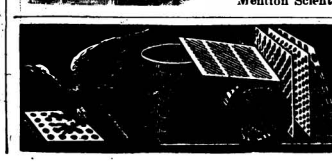

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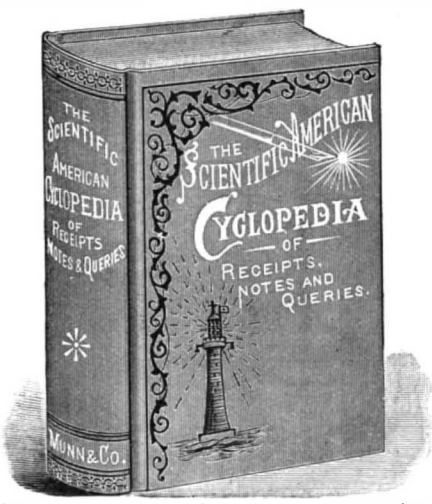

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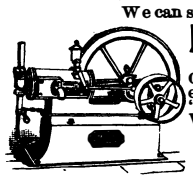

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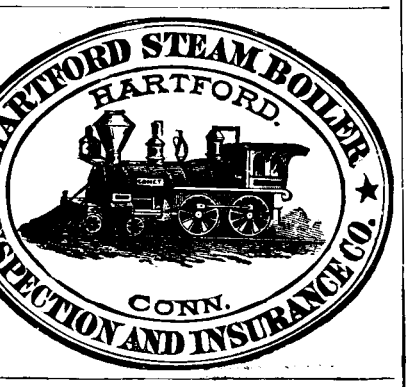

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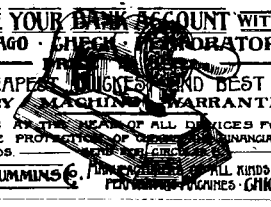

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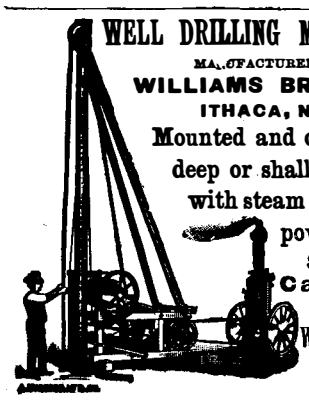

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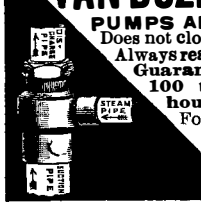

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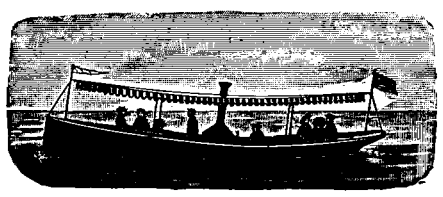

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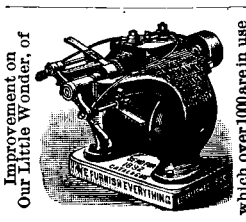

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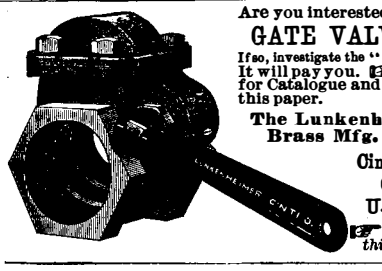

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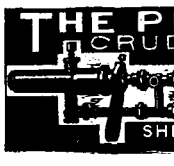

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